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November 14, 2013

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EPA CONTRACT NUMBER EP-W-10-033
TASK ORDER NUMBER 2019
QUALITY ASSURANCE SUPPORT FOR THE LIBBY ASBESTOS SITE

Dear Ms. Zinner:

Enclosed please find the final version of the Annual Summary QA Report (2010-2012). This report is a deliverable under Task 8 of Task Order 2019.

If you have any questions, please feel free to contact me.

Sincerely,

Timothy Vonnahme

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ANNUAL QA/QC SUMMARY REPORT (2010-2012)

FOR

TASK ORDER 2019
QUALITY ASSURANCE (QA) SUPPORT FOR THE LIBBY ASBESTOS SITE

Prepared by:

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November 14, 2013

QATS Contract Number: EP-W-10-033

Prepared for:

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OFFICE OF SUPERFUND REMEDIATION AND TECHNOLOGY INNOVATION
U. S. ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

Table of Contents

Acronym List

<	Less Than
≥	Greater Than or Equal To
%	Percent
AHERA	Asbestos Hazard Emergency Response Act
AOC	Administrative Order on Consent
ASTM	American Society for Testing and Materials
CH	Chrysotile
COC	Chain-Of-Custody
CSF	Close Support Facility
EDD	Electronic Data Deliverable
EPA	Environmental Protection Agency
ESAT	Environmental Services Assistance Team
f/cc	Fibers per Cubic Centimeter
f/mm2	Fibers per Square Millimeter
FB	Field Blank
FG	Finely Ground
ISO	International Organization for Standardization
ISSI	ISSI Consulting Group, Inc.
LA	Libby Amphibole
LC	Laboratory Coordinator
LDC	Laboratory Duplicate Cross-check
LDS	Laboratory Duplicate Self-check
MAS	Material Analytical Services, LLC
MFL	Million Fibers per Liter
ND	Non-Detect
NVLAP	National Voluntary Laboratory Accreditation Program
OU	Libby Operable Unit
PCM	Phase Contrast Microscopy
PCME	PCM-Equivalent
PES	Performance Evaluation Sample
PLM	Polarized Light Microscopy
PLM-GRAV	Polarized Light Microscopy Gravimetric
PLM-VE	Polarized Light Microscopy-Visual Area Estimation
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QARD	Quality Assurance Reference Document
QATS	Quality Assurance Technical Support
RD	Recount Different
RI/FS	Remedial Investigation/Feasibility Study
RS	Recount Same
SAED	Selected Area Electron Diffraction
SAP	Sampling and Analysis Plan
s/cc	Structures per Cubic Centimeter
SOP	Standard Operating Procedure
SPF	Soil Preparation Facility
SRM	Solid Reference Material
TEM	Transmission Electron Microscopy
VA	Verified Analysis

1.0 Introduction

1.1 Purpose of this Report

This Annual Summary Report is a requirement of Task 8 of Task Order 2-019, *Quality Assurance/Quality Control (QA/QC) Support for Libby Asbestos Site*, issued to Shaw Environmental, Inc. (a CB&I Company) on November 14, 2012 by U.S. Environmental Protection Agency Region 8. The purpose of this report is to provide an updated summary of the Quality Assurance (QA) activities conducted from analyses performed on samples collected from Libby Superfund Site Operable Units (OUs) 1, 2, 4, 5, 6, 7, and 8 from 2010 through 2012. This report also summarizes the results for a variety of different types of Quality Control (QC) samples that have been collected from these OUs across the various sampling programs, provides an assessment of the overall quality of the data, and includes recommendations for refining and strengthening the QA/QC program in the future. Note that the QA/QC data from the OU3 site, which includes the Libby Vermiculite Mine, is not included in this report. The Annual QA/QC Summary Report (2007-2012) specific to the OU3 site was submitted to EPA on September 5th, 2013.

1.2 Report Outline

The elements provided in this report are as defined in the Task Order, and include:

- QC Data Evaluated
- Asbestos Data Validation
- Laboratory On-site Audits
- Laboratory Mentoring Program
- Laboratory Modifications
- Conclusions and Recommendations
- References

The QC data summarized in this report includes data from the preparation and analysis of samples collected from the various OUs. The data evaluated for some of the above elements span multiple years. For example, the QC data evaluated and asbestos data validation includes data collected from 2010 through 2012, and the laboratory on-site audits include evaluations performed at EPA's support laboratories in 2008 and 2012. Where possible, QA/QC trends (e.g., year-over-year performance in duplicate QC sample concordance rates or trends on-site laboratory audit defects) are illustrated and discussed in the report.

2.0 QC Data Evaluated

The QC data described in this section were collected from the Libby Superfund Site OUs (with the exception of OU3) from 2010 through 2012. This section summarizes the results by the following categories:

- Field QC
- Preparation QC
- Laboratory Analysis QC
- Performance Evaluation Sample (PES) Results

2.1 Field Quality Control

Field-based QC samples are samples collected in the field and submitted to the laboratory along with the regular field samples for analysis. Four types of field QC samples were collected at the various OUs from 2010 through 2012:

- Field Blanks
- Rinsate Blanks
- Lot Blanks
- Field Duplicates

Field QC samples were collected with samples designated for analysis by PLM-Visual Estimation (VE), Phase Contrast Microscopy (PCM), and Transmission Electron Microscopy (TEM).

The number of field QC samples collected in 2010-2012 is listed in **Tables 1-3** below by year, analysis method, and media. The percentage of QC samples to the total number of field samples collected are reported as percentage (%) in the tables. Field QC frequencies are defined in the applicable Sampling and Analysis Plan (SAP), with varying frequencies for the different sampling events and media:

- Field Blanks – Are collected for air, water and dust samples with varying frequencies (i.e. one per day per site with 10% selected weekly and shipped to the laboratory for TEM analysis)
- Field Duplicates – Are collected for air, soil, water, duff, and Tree bark, and are typically collected at a frequency of 5% (1 in 20) or one per sampling event.
- Lot Blanks – Are analyzed for air and dust samples at a frequency of 1 per 500 cassettes or filter cassette lot.
- Rinsates – Are collected at a rate of 1 per contamination effort for tree bark samples when non-dedicated equipment is used.

PLM Field QC

The field QC samples collected for PLM include only field duplicates. From 2010 through 2012 a total of 669 PLM field duplicates were collected with the 14,536 field samples collected for PLM analysis by the visual estimate (VE) which represents 4.6% of the total number of field samples collected. Field QC samples were not required for the 4,113 samples collected for PLM analyses by NIOSH Method 9002. Of the 669 PLM field duplicates, 45 field duplicates were analyzed by the PLM gravimetric procedure for samples collected that yielded a coarse fraction during the sample sieving and grinding procedures. **Table 1** provides a summary of the field QC samples collected by year, method, and media.

Table 1 - PLM Field QC, 2010 – 2012

				Field Duplicates	
Year	**Method**	**Media**	**Field Samples**	**Collected**	**%**
2010	PLM-VE	Soil	4605	207	4.5%
2011	PLM-VE	Soil	3957	183	4.6%
2012	PLM-VE	Soil	5974	279	4.7%
	Totals		**14536**	**669**	**4.6%**

TEM Field QC

Field QC samples for TEM analyses, which include field duplicates, rinsate blanks, field blanks, and lot blanks, were collected along with the various media from 2010 through 2012. Of the 6,793 total samples collected for TEM analysis during this period for all TEM methods and media, 1,230 total field duplicate and blank QC samples were applied, which represents an overall frequency of 18.1%. **Table 2** provides a summary of the type, number, and frequency of TEM Field QC samples by year, methodology, and media.

Table 2 - TEM Field QC, 2010 - 2012

				Field Duplicates		Rinsate Blanks		Field Blanks		Lot Blanks	
Year	Method	Media	Field Samples	Collected	%	Collected	%	Collected	%	Collected	%
2010	ISO 10312	Air	680	37	12.9%	N/A	N/A	88	12.9%	12	1.8%
		Water	13	1	7.7%	N/A	N/A	2	15.4%	N/A	N/A
	AHERA	Air	1803	N/A	N/A	N/A	N/A	315	17.5%	10	0.6%
	ASTM D5755	Dust	114	0	0.0%	N/A	N/A	29	25.4%	1	0.9%
2011	ISO 10312	Air	598	31	5.2%	N/A	N/A	78	13.0%	24	4.0%
		Water	75	2	2.7%	N/A	N/A	2	2.7%	N/A	N/A
		Soil	18	0	0.0%	N/A	N/A	N/A	N/A	N/A	N/A
		Bulk and Vermiculite	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	AHERA	Air	1133	N/A	N/A	N/A	N/A	169	14.9%	7	0.6%
	ASTM D5755	Dust	63	0	0.0%	N/A	N/A	8	12.7%	0	0.0%
2012	ISO 10312	Air	560	23	4.1%	N/A	N/A	105	18.8%	15	2.7%
		Brush, Bark, Debris, Ash,Duff	133	11	8.3%	0	0.0%	N/A	N/A	N/A	N/A
		Bulk and Vermiculite	9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Soil	81	5	6.2%	N/A	N/A	N/A	N/A	N/A	N/A
		Water	240	17	7.1%	2	0.8%	17	7.1%	N/A	N/A
	AHERA	Air	1234	N/A	N/A	N/A	N/A	202	16.4%	8	0.6%
	ASTM D5755	Dust	38	0	0.0%	N/A	N/A	9	23.7%	0	0.0%
	Totals		**6793**	**127**	**1.9%**	**2**	**<0.1%**	**1024**	**15.1%**	**77**	**1.1%**

PCM Field QC – NIOSH 7400

Field QC samples for PCM analyses were applied to air samples collected and analyzed by the NIOSH 7400 Method from 2010 through 2012. PCM field QC samples include field blanks and lot blanks. Of the 2,239 total samples collected for PCM analysis during this period, 79 field blanks and 23 lot blanks were collected and analyzed, which represents 4.6% of the total. **Table 3** shows the number and frequency of PCM Field QC samples by year.

Table 3 - PCM Field QC, 2010 – 2012

				Field Blanks		Lot Blanks	
Year	Method	Media	Field Samples	Collected	%	Collected	%
2010	NIOSH 7400	Air	986	35	3.5%	7	0.7%
2011	NIOSH 7400	Air	664	20	3.0%	8	1.2%
2012	NIOSH 7400	Air	589	24	4.1%	8	1.4%
	Totals		**2239**	**79**	**3.5%**	**23**	**1.0%**

2.1.1 Field Blanks

A field blank is a sample of the same medium as the associated field samples used to determine if cross-contamination has occurred during sample collection and/or analysis. Field blank collection frequency requirements are specified in the associated SAPs. As indicated in **Tables 2 and 3**, between 2010 - 2012 a total of 1,024 field blanks were collected with 6,793 TEM field samples, which represents a frequency of 15.1%; and 79 air field blanks were collected with 2,239 PCM air samples, which represents a frequency of 3.5%. A review of the PCM field blanks associated with the OU7 site identified two blanks that exceeded the 7 structures per 100 field criteria described in the method. **Table 4** below is a summary of the blanks, the associated samples, Qualifier, and Reason Codes that should be added to the database to alert users of the potential for bias high results.

Table 4 - PCM Field Blank Contamination from OU7 Samples

Field Blank No.	Event ID	Location	Associated Samples	Method	Date Collected	Fibers	Qualifier	Reason Code
TTHASP-042011	TTHASP-042011	AD-OUTQC	TT-12682	PCM-7400	22-Aug-12	19	(1)	(1)
	TTHASP-042011	AD-OUTQC	TT-12689	PCM-7400	22-Aug-12	4	J	B
	TTHASP-042011	AD-OUTQC	TT-12690	PCM-7400	22-Aug-12	3	J	B
	TTHASP-042011	AD-OUTQC	TT-12691	PCM-7400	22-Aug-12	2	J	B
TTHASP-042011	TTHASP-042011	BD-202756	TT-12474	PCM-7400	15-Jun-11	7.5	(1)	(1)
	TTHASP-042011	BD-202756	TT-12472	PCM-7400	15-Jun-11	7.5	J	B
	TTHASP-042011	BD-202756	TT-12473	PCM-7400	15-Jun-11	17	J	B

(1) Indicates sample is a field blank.

A review of the field blank data associated with samples collected for analysis by TEM revealed no structures detected in any of these samples. Field blanks are not required for duff, soil, tree bark, and other solid media.

2.1.2 Rinsate Blanks

Rinsate blanks are used to determine whether the decontamination procedures applied to field equipment are adequate to prevent cross-contamination of samples during collection. Rinsate blanks are prepared by rinsing contaminated field equipment with analyte-free reagent water and are only required when non-dedicated equipment is used. As shown in **Table 2**, during the period of 2010 through 2012, only two (2) rinsate blanks associated water samples were collected in 2012, neither of which contained asbestos structures. For the remaining samples (i.e. tree bark) rinsates were not collected and it is assumed that dedicated equipment was used during sample collection.

2.1.3 Lot Blanks

Before air filter cassettes can be used for asbestos sampling for TEM and PCM analyses, the filter lot must be determined to be asbestos-free. To accomplish this, lot blanks are selected at random from each group of cassettes to be used for the collection of air and dust samples. The lot blanks are analyzed for asbestos fibers by the same method that will be used for field sample analyses. If any asbestos fibers are detected on the lot blanks, the entire batch of cassettes is rejected. Only lots of filters with acceptable lot blank results are placed in the general supply area for use by project personnel.

As shown in **Table 2 and Table 3**, a total of 77 TEM air filter cassette and 23 PCM air filter cassette lot blanks were collected and analyzed between 2010 and 2012. No asbestos structures were observed in any of the lot blanks analyzed.

2.1.4 Field Duplicates

A field duplicate is a second sample that is collected at the same location or coordinates, and at approximately the same time as the original field sample, using the same collection technique. Field duplicates are used to evaluate variability due to small-scale media heterogeneity, along with analytical precision. Because field duplicate samples are expected to have inherent variability that is random and may be either small or large, there is no quantitative requirement for the agreement of field duplicates. Rather, results are used to determine the magnitude of this variability to evaluate data usability. For samples collected from 2010 through 2012, as shown in **Tables 1-2**, 669 soil field duplicate pairs were collected for samples prepared and analyzed by PLM, and 127 air, water, duff and tree bark field duplicate pairs were collected for samples prepared and analyzed by TEM. With the exception of the following, field duplicates for all media types were collected at a frequency of 5% or greater:

- According to the SAP, dust samples with the prefix “TT” indicate that field duplicates should have been collected at a frequency of 5%; however, no field duplicates for these samples were present in the OU7 (Troy) database.

2.1.4.1 TEM Field Duplicates Results Comparisons

The LA concentration estimates derived from the original and duplicate samples were compared using the method for comparison of two Poisson rates described by Nelson (1982), based on a 90% confidence interval (CI). Of the 127 duplicate pairs collected for TEM analysis, only one of the duplicate pairs (0.8%) was statistically different, suggesting generally good reproducibility of air, water, tree bark, duff, and soil results from co-located samples (see **Table 5** below). It should also be noted that 95 (75%) of the 127 duplicate pairs reviewed contained no structures.

Table 5 - Statistical Comparison of Two Poisson Rates

Parent ID	Field Dupl. ID	Method	Media	First Evaluation (Rate 1)			Re-prep. Evaluation (Rate 2)			Poisson Ratio Rate Comparison (CI=90%)
				Struct. Count	Sensitivity [a]	Conc [a]	Struct. Count	Sensitivity [a]	Conc [a]	
FB-00003	FB-00004	TEM-ISO	Soil	43	1.52E+04	6.55E+05	50	1.11E+05	5.54E+06	[0.08-0.17] Rate 1 < Rate 2

[a] soil sensitivity units: s/gram

2.1.4.2 PLM-VE Field Duplicate Result Comparisons

Field duplicate results analyzed by PLM-VE are ranked as concordant (in agreement) if both the original sample result and the field duplicate result report the same semi-quantitative classification. Results are ranked as weakly discordant if the original sample result and the field duplicate result differ by one semi-quantitative classification (e.g., Bin A vs. Bin B1). Results are ranked as strongly discordant if the original sample result and the field duplicate result differ by more than one semi-quantitative classification (e.g., Bin A vs. Bin B2).

Table 6 summarizes the results of the original and field PLM-VE duplicates for soil samples collected in 2010. One hundred seventy three (173) of the 207 original duplicate pairs were found to be in concordance (84%), and 34 (16%) were ranked as weakly discordant.

Table 6 - 2010 PLM-VE Field Duplicate Summary

			Field Duplicate Results			
			Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
			A	B1	B2	C
Original Sample Results	Bin A (ND)	A	145	18	0	0
	Bin B1 (Tr)	B1	16	28	0	0
	Bin B2 (<1%)	B2	0	0	0	0
	Bin C (≥1%)	C	0	0	0	0
Total Pairs			207			
N Concordant			173			
N Weakly Discordant			34			
N Strongly Discordant			0			
Concordant			84%			
Weakly Discordant			16%			
Strongly Discordant			0%			

Table 7 summarizes the results of the original and field PLM-VE duplicates for soil samples collected in 2011. One hundred sixteen (116) of the 183 original duplicate pairs were found to be in concordance (63%), and 67 (37%) were ranked as weakly discordant.

Table 7 - 2011 PLM-VE Field Duplicate Summary

			Field Duplicate Results			
			Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
			A	B1	B2	C
Original Sample Results	Bin A (ND)	A	95	30	0	0
	Bin B1 (Tr)	B1	36	21	0	0
	Bin B2 (<1%)	B2	0	1	0	0
	Bin C (≥1%)	C	0	0	0	0
Total Pairs			183			
N Concordant			116			
N Weakly Discordant			67			
N Strongly Discordant			0			
Concordant			63%			
Weakly Discordant			37%			
Strongly Discordant			0%			

Table 8 summarizes the results of the original and field PLM-VE duplicates for soil samples collected in 2012. Two hundred sixty-five (265) of the 279 original duplicate pairs were found to be in concordance (95%), and 14 (5%) were ranked as weakly discordant.

Table 8 - 2012 PLM-VE Field Duplicate Summary

			Field Duplicate Results			
			Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
			A	B1	B2	C
Original Sample Results	Bin A (ND)	A	238	14	0	0
	Bin B1 (Tr)	B1	0	26	0	0
	Bin B2 (<1%)	B2	0	0	1	0
	Bin C (≥1%)	C	0	0	0	0
Total Pairs			279			
N Concordant			265			
N Weakly Discordant			14			
N Strongly Discordant			0			
Concordant			95%			
Weakly Discordant			5%			
Strongly Discordant			0%			

2.1.4.3 PLM-GRAV

Forty-five (45) of the 669 field duplicate samples collected for PLM-VE analysis yielded a coarse fraction that was analyzed using the PLM-GRAV procedure, all of which were non-detect for both the field duplicate and parent samples.

2.2 Preparation Quality Control

Soil samples delivered to the Troy Soil Preparation Facility (SPF) are processed in accordance with the latest revision of SOP ISSI-LIBBY-01, which includes processes for drying, splitting, sieving, grinding, and archiving of soil samples. Once processed, the resulting fine ground and/or coarse fractions are submitted for analysis by the Libby-specific PLM methods (PLM-GRAV and PLM-VE). The purpose of grinding the samples to a uniform size prior to shipping for analysis is to remove the potential variability introduced by having each of the laboratories grind their own samples. In order to ensure proper sample handling and decontamination of soil sample preparation equipment at the Troy SPF, preparation QC samples are also collected. These samples are assigned unique field identifiers and are submitted blindly to the analytical laboratories along with the field samples. Two types of preparation QC samples were utilized for PLM analyses at the SPF; preparation blanks (i.e., drying and grinding) and preparation duplicates. Of the 14,765 soil/sediment samples collected at Libby Superfund Site OUs for PLM analysis from 2010 through 2012, 2,352 (15.9%) preparation QC duplicate and blank samples were also collected (see **Table 9**).

Table 9 - SPF PLM Preparation QC 2010 – 2012

Year	Method	Media	Field Samples	Prep Duplicates		Grinding Blanks		Drying Blanks	
				No. of Samples	%	No. of Samples	%	No. of Samples	%
2010	PLM-VE	Soil	4369	296	6.8%	238	5.4%	285	6.5%
2011	PLM-VE	Soil	4154	262	6.3%	175	4.2%	264	6.4%
2012	PLM-VE	Soil	6242	351	5.6%	184	2.9%	297	4.8%
	Totals		**14765**	**909**	**6.2%**	**597**	**4.0%**	**846**	**5.7%**

2.2.1 Preparation Blanks (Drying Blanks and Grinding Blanks)

2.2.1.1 Drying Blanks

Drying blanks consist of aliquots of asbestos-free quartz sand processed with each batch of field samples (i.e., group of routine and QC samples that are prepared for analysis at the same time). Drying blanks are used to determine if cross-contamination is occurring during sample processing (i.e., drying, sieving, grinding, and splitting) and should be prepared at a rate of at least one per 20 field samples (5%). As shown in **Table 9**, a total of 846 drying blanks were prepared from 2010 through 2012, which is 5.7% of the field samples processed. All drying blank sample results were reported as non-detect (Bin A) by PLM-VE, suggesting that the procedures utilized to dry the samples were effective in not introducing LA contamination.

2.2.1.2 Grinding Blanks

Grinding blanks consist of asbestos-free quartz sand processed at a frequency of one per day. Like the drying blanks, grinding blanks are used to determine if cross-contamination has occurred during or after the grinding process. As shown in **Table 9**, a total of 597 grinding blanks were prepared from 2010 through 2012, which is 4.0% of the field samples processed. All grinding blank sample results were reported as non-detect (Bin A) by PLM-VE, suggesting that the procedures utilized to grind the samples were effective in not introducing LA contamination.

2.2.2 Preparation Duplicates

Preparation duplicates are created by dividing a sample designated for PLM analysis into two parts after drying, but prior to sieving and grinding. Preparation duplicates are prepared at a frequency of 5%. As shown in **Table 9**, a total of 909 preparation duplicates were prepared from 2010 through 2012, which is 6.2% of the field samples processed. Comparison of the preparation duplicate results with the paired original field sample results is used to evaluate the variability that may occur during preparation and analysis.

2.2.2.1 PLM-VE Preparation Duplicate Result Comparison

Similar to field duplicates, preparation duplicates for PLM-VE are ranked as concordant if both the original sample results and the preparation duplicate results display the same semi-quantitative PLM-VE classification.

Table 10 summarizes the results of the original and PLM-VE preparation duplicate samples collected in 2010. Of the 296 preparation duplicates, 190 (64%) were concordant and 106 (36%) were weakly discordant.

Table 10 - 2010 SPF PLM-VE Preparation Duplicate Summary

			Preparation Duplicate Results			
			Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
			A	B1	B2	C
Original Sample Results	Bin A (ND)	A	176	50	0	0
	Bin B1 (Tr)	B1	54	13	2	0
	Bin B2 (<1%)	B2	0	0	1	0
	Bin C (≥1%)	C	0	0	0	0
Total Pairs			296			
N Concordant			190			
N Weakly Discordant			106			
N Strongly Discordant			0			
Concordant			64%			
Weakly Discordant			36%			
Strongly Discordant			0%			

Table 11 summarizes the results of the original and PLM-VE preparation duplicate samples collected in 2011. Of the 262 preparation duplicates, 200 (76%) were concordant and 62 (24%) were weakly discordant.

Table 11 - 2011 SPF PLM-VE Preparation Duplicate Summary

			Preparation Duplicate Results			
			Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
			A	B1	B2	C
Original Sample Results	Bin A (ND)	A	161	35	0	0
	Bin B1 (Tr)	B1	27	39	0	0
	Bin B2 (<1%)	B2	0	0	0	0
	Bin C (≥1%)	C	0	0	0	0
Total Pairs			262			
N Concordant			200			
N Weakly Discordant			62			
N Strongly Discordant			0			
Concordant			76%			
Weakly Discordant			24%			
Strongly Discordant			0%			

Table 12 summarizes the results of the original and PLM-VE preparation duplicate samples collected in 2012. Of the 351 preparation duplicates, 305 (87%) were concordant, 45 (13%) were weakly discordant, and one pair (<1%) was strongly discordant.

Table 12 - 2012 SPF PLM-VE Preparation Duplicate Summary

			Preparation Duplicate Results			
			Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
			A	B1	B2	C
Original Sample Results	Bin A (ND)	A	297	19	1	0
	Bin B1 (Tr)	B1	26	8	0	0
	Bin B2 (<1%)	B2	0	0	0	0
	Bin C (≥1%)	C	0	0	0	0
Total Pairs			351			
N Concordant			305			
N Weakly Discordant			45			
N Strongly Discordant			1			
Concordant			87%			
Weakly Discordant			13%			
Strongly Discordant			<1%			

2.2.2.2 PLM-GRAV Preparation Duplicates Result Comparison

One hundred eighty-three (183) of the 909 preparation duplicate samples prepared for PLM-VE analysis yielded a coarse fraction that was analyzed using the PLM-GRAV procedure, all of which were non-detect for both the preparation duplicate and parent sample.

2.3 Laboratory Analysis Quality Control

A variety of laboratory-based QC analyses are performed for TEM and PLM sample analyses, which can be used to assess the quality of the associated data. The results of laboratory QC applied to samples collected from Libby Superfund Site OUs (excluding the OU3 site) from 2010 through 2012 are described in the sections below. The QC analyses associated with PCM analyses were not submitted and could therefore not be assessed.

2.3.1 TEM Laboratory QC

The laboratory QC analyses required for Libby TEM analyses include Laboratory blanks (LB), Recount Different (RD), Recount Same (RS), Verified Analysis (VA), Re-preparation (RP), and Inter-laboratory (IL). Each of these TEM laboratory QC have the following program-wide frequency requirements, as described in the most recent revision of Laboratory Modification LB-000029:

- Laboratory blanks (4%)
- Recount Different (2.5%)
- Recount Same (1%)
- Verified Analysis (1%)
- Re-preparations (1%)
- Inter-laboratory analyses (0.5%)

Table 13 provides a summary of the number and frequency at which laboratory QC analyses were performed by laboratory and year on a program-wide basis from 2010 through 2012.

Table 13 - TEM Laboratory QC Summary

			Lab Blanks* (Freq. Goal = 4%)		Re-preparations (Freq. Goal = 1%)		Recount Different Freq. Goal = 2.5%)		Recount Same (Freq. Goal = 1%)		Inter-Laboratory Freq. Goal = 0.5%)		Verified Analysis (Freq. Goal = 1%)	
Year	Laboratory	Sample Analyses	Blanks	%	RP	%	RD	%	RS	%	IL	%	VA	%
2010	EMSL04	5	0	0.0%	0	0.0%	0	0.0%	0	0.0%	-	-	0	0.0%
	EMSL19	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%	-	-	0	0.0%
	EMSL22	81	4	4.9%	1	1.2%	1	1.2%	2	2.5%	3	3.7%	0	0.0%
	EMSL27	2975	91	3.1%	16	0.5%	82	2.8%	46	1.5%	15	0.5%	21	0.7%
	ESAT R8	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hygeia	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reservoirs	89	2	2.2%	0	0.0%	2	2.2%	0	0.0%	3	3.4%	1	1.1%
2011	EMSL04	33	11	33.3%	0	0.0%	0	0.0%	0	0.0%	-	-	0	0.0%
	EMSL19	24	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	4.2%	0	0.0%
	EMSL22	299	27	9.0%	4	1.3%	7	2.3%	5	1.7%	5	1.7%	1	0.3%
	EMSL27	1772	55	3.1%	4	0.2%	64	3.6%	13	0.7%	12	0.7%	20	1.1%
	ESAT R8	25	3	12.0%	2	8.0%	0	0.0%	1	4.0%	-	-	0	0.0%
	Hygeia	33	0	0.0%	0	0.0%	1	3.0%	0	0.0%	2	6.0%	1	3.0%
	Reservoirs	60	4	6.7%	0	0.0%	1	1.7%	1	1.7%	2	3.3%	1	1.7%
2012	EMSL04	69	13	18.8%	1	1.4%	5	7.2%	2	2.9%	4	5.8%	1	1.4%
	EMSL19	15	2	13.3%	0	0.0%	1	6.7%	0	0.0%	2	13.3%	0	0.0%
	EMSL22	111	14	12.6%	2	1.8%	7	6.3%	4	3.6%	4	3.6%	1	0.9%
	EMSL27	1897	70	3.7%	8	0.4%	48	2.5%	38	2.0%	9	0.5%	14	0.7%
	ESAT R8	214	13	6.1%	3	1.4%	6	2.8%	4	1.9%	6	2.8%	2	0.9%
	Hygeia	241	11	4.6%	3	1.2%	4	1.7%	2	0.8%	8	3.3%	2	0.8%
	Reservoirs	260	13	5.0%	4	1.5%	7	2.7%	3	1.2%	7	2.7%	0	0.0%
	Totals	**8205**	**333**	**4.1%**	**48**	**0.6%**	**236**	**2.9%**	**121**	**1.5%**	**83**	**1.0%**	**65**	**0.8%**

*This category includes preparation, filtration and drying blanks.

Areas of discordance between the required frequencies versus the percentage actually performed are highlighted in yellow. It should be noted that some of these discrepancies are a result of the laboratories not having received the number of samples necessary to initiate the performance of specific QC types, and that the overall frequencies, with the exception of the re-preparations, were performed at the required frequencies on a program-wide basis. Note that the re-preparations and verified analyses were performed at approximately 0.6% and 0.8%, respectively, which is slightly less than the requirement of 1%. With the exception of EMSL27, the majority of the laboratories did not receive the 100 annual samples necessary to initiate re-preparations. EMSL27 performed re-preparations at a rate of 0.5%, 0.2% and 0.4% for 2010, 2011 and 2012, respectively.

2.3.1.1 TEM Laboratory Blanks

Laboratory blanks are prepared from new, unused filters and analyzed using the same procedures used to analyze the associated field samples. The purpose of a laboratory blank is to determine the presence of any significant sources of asbestos contamination during sample preparation and analysis in the TEM laboratory. As **Table 13** shows, a total of 333 TEM laboratory blanks were analyzed by the participating laboratories from 2010 through 2012. No asbestos structures were observed, suggesting that the sample preparation and analysis

procedures performed by the laboratories were effective in not introducing asbestos contamination.

2.3.1.2 TEM Recounts

A recount analysis is a re-examination of the original TEM grid openings to verify the reported asbestos structure counts and characteristics. Three types of recount analyses were performed by the TEM analytical laboratories:

- Recount Same (RS) – RS is a TEM analysis where the original grid openings are re-examined by the same microscopist who performed the initial examination.
- Recount Different (RD) – RD is a TEM analysis where the original grid openings are re-examined by a microscopist within the same laboratory who did not perform the initial examination.
- Verified Analysis (VA) – VA analysis is similar to RD but with different documentation requirements. A VA must be recorded in accordance with the NIST (1994) protocol requirements.

Recount analyses were compared with the original analysis on a grid opening (GO)-by-GO, and structure-by-structure basis, with only those GOs that were able to be re-examined during the recount analysis included in the evaluation; in some instances grid openings may have been damaged with no alternates available. The degree of concordance between the original analysis and the recount analysis was evaluated based on the total number of countable LA structures observed for each grid opening that was re-examined. The concordance metrics (Structures per GO, Mineral Class, Structure Length, and Structure Width), as defined in LB-000029D, are summarized below.

- Number of LA Structures per GO - For grid openings with 10 or fewer structures, counts must match exactly. For grid openings with more than 10 structures, counts must be within 10 percent (%).
- Asbestos Mineral Class (LA, OA, or CH) - The class of structure must agree 100% on CH vs. amphibole. For assignment of amphiboles to LA or OA bins, there must be agreement on at least 90% of all amphibole structures.
- Structure Length - Fibers and bundles must agree within 0.5 micrometers (µm) or 10%, whichever is less stringent. Clusters and matrices must agree within 1 µm or 20%, whichever is less stringent.
- Structure Width - Fibers and bundles must agree within 0.5 µm or 20%, whichever is less stringent. For clusters and matrices, there is no quantitative rule for concordance.

The program wide concordance criteria, as defined in LB-000029D, are summarized in **Table 14**.

Table 14 - Recount Program-Wide Criteria

Metric	Program-wide Criteria		
	Good	Acceptable	Poor
Concordance on LA Structures per GO	>95%	85% - 95%	<85%
Concordance on Mineral Class	>99%	95% - 99%	<95%
Concordance on Length	>90%	80% - 90%	<80%
Concordance on Width	>90%	80% - 90%	<80%

As shown in **Table 13**, a total of 121 RS, 236 RD, and 65 VA analyses were performed from samples collected at Libby Superfund Site OUs (except for OU3) from 2010 through 2012. **Tables 15-17** provide pass percent summaries, by year and media, of the combined recount results with regard to the criteria stated above for Mineral Class, Structure Length, Structure Width, and matched Structures per Grid Opening, and also the program-wide criteria defined in **Table 14**.

Table 15 - 2010 Recounts

Results for Matched LA Structures									
Media	**Attribute**	**Total**	**Pass**	**%**	**Media**	**Attribute**	**Total**	**Pass**	**%**
Air	Mineral Class	22	22	100%	Dust[1]	Mineral Class	0	N/A	N/A
	Structure Length	22	22	100%		Structure Length	0	N/A	N/A
	Structure Width	22	22	100%		Structure Width	0	N/A	N/A
	Structure per GO	18	18	100%		Structures per GO	N/A	N/A	N/A
					Total	**Mineral Class**	**22**	**22**	**100%**
						Structure Length	**22**	**22**	**100%**
						Structure Width	**22**	**22**	**100%**
						Structure per GO	**18**	**18**	**100%**

1-No structures detected

As illustrated in **Table 15** above, all attributes of the 22 structures identified in the original 2010 analyses of air media samples versus those identified in the combined recount analyses are within the “Good” range of the program-wide criteria (**Table 14**) specified for Mineral Class, Structure Length, Structure Width, and Structures per GO.

Table 16 - 2011 Recounts

Results for Matched LA Structures									
Media	**Attribute**	**Total**	**Pass**	**%**	**Media**	**Attribute**	**Total**	**Pass**	**%**
Air	Mineral Class	94	89	95%	Dust[1]	Mineral Class	0	N/A	N/A
	Structure Length	94	81	86%		Structure Length	0	N/A	N/A
	Structure Width	94	90	96%		Structure Width	0	N/A	N/A
	Structure per GO	63	60	95%		Structures/GO	N/A	N/A	N/A
Water[1]	Mineral Class	N/A	N/A	N/A	**Total**	**Mineral Class**	**94**	**89**	**95%**
	Structure Length	N/A	N/A	N/A		**Structure Length**	**94**	**81**	**86%**
	Structure Width	N/A	N/A	N/A		**Structure Width**	**94**	**90**	**96%**
	Structure per GO	N/A	N/A	N/A		**Structure per GO**	**63**	**60**	**95%**

1-No structures detected

As illustrated in **Table 16** above, all attributes of the 94 structures identified in the original 2011 analyses of air media samples versus those identified in the combined recount analyses are within the “Good” or “Acceptable” range of the program-wide criteria (**Table 14**) specified for Mineral Class, Structure Length, Structure Width, and Structures per GO.

Table 17 - 2012 Recounts

Results for Matched LA Structures									
Media	**Attribute**	**Total**	**Pass**	**%**	**Media**	**Attribute**	**Total**	**Pass**	**%**
Air	Mineral Class	80	70	88%	Water	Mineral Class	3	2	67%
	Structure Length	80	80	100%		Structure Length	3	3	100%
	Structure Width	80	78	98%		Structure Width	3	3	100%
	Structure per GO	74	71	96%		Structure per GO	3	3	100%
Soil	Mineral Class	79	63	80%	Duff	Mineral Class	1	1	100%
	Structure Length	79	78	99%		Structure Length	1	1	100%
	Structure Width	79	76	96%		Structure Width	1	1	100%
	Structure per GO	38	37	97%		Structure per GO	1	1	100%
Tree Bark	Mineral Class	28	28	100%	**Total**	**Mineral Class**	**191**	**164**	**86%**
	Structure Length	28	27	96%		**Structure Length**	**191**	**189**	**99%**
	Structure Width	28	28	100%		**Structure Width**	**191**	**186**	**97%**
	Structure per GO	4	4	100%		**Structure per GO**	**120**	**116**	**97%**

As illustrated in **Table 17** above, with the exception of the mineral class criteria for air, soil and water, which fall into the “Poor” category, all attributes of the 191 structures identified in the original 2012 analyses versus those identified in the combined recount analyses are within the “Good” or “Acceptable” range of the program-wide criteria (**Table 14**) specified for Mineral Class, Structure Length, Structure Width, and Structures per GO.

2.3.1.3 TEM Re-preparations

A re-preparation is the re-analysis of a sample where new grids are prepared using a new portion of the same field sample filter used to prepare the original grids. The 2010-2012 re-preparation results were compared using the method for comparison of two Poisson rates described by Nelson (1982), based on a 90% confidence interval (CI). Of the 48 re-preparation pairs analyzed from 2010 through 2012, all 48 (100%) are within the 90% CI. It should be noted that the results for 33 of the 46 re-preparation pairs were reported as non-detect.

2.3.1.4 TEM Inter-laboratory Analyses

Samples for TEM inter-laboratory analyses were selected in accordance with the most recent revision of Laboratory Modification LB-000029. Once selected, the list was provided to each of the participating laboratories, who then retrieved the sample(s) from their archive storage, prepared the necessary TEM grids, analyzed the samples, prepared the necessary paperwork, and shipped the grids to the laboratory selected to perform the inter-laboratory analyses. The criteria for inter-laboratory analyses are the same as those for the other recount analyses, which are described in **Section 2.3.1.2** above. **Tables 18-20** provide a summary of the results by year and media:

Table 18 - 2010 OU7/Site-wide Inter-laboratory Analyses

Results for Matched LA Structures									
Media	**Attribute**	**Total**	**Pass**	**%**	**Media**	**Attribute**	**Total**	**Pass**	**%**
Air	Mineral Class	65	56	86%	Water	Mineral Class	7	7	100%
	Structure Length	65	40	62%		Structure Length	7	2	29%
	Structure Width	65	61	94%		Structure Width	7	7	100%
	Structure per GO	31	22	71%		Structure per GO	6	6	100%

Table 18 - 2010 OU7/Site-wide Inter-laboratory Analyses

Results for Matched LA Structures									
Media	**Attribute**	**Total**	**Pass**	**%**	**Media**	**Attribute**	**Total**	**Pass**	**%**
Dust	Mineral Class	1	1	100%	**Total**	**Mineral Class**	**73**	**64**	**88%**
	Structure Length	1	1	100%		**Structure Length**	**73**	**43**	**59%**
	Structure Width	1	1	100%		**Structure Width**	**73**	**69**	**95%**
	Structure per GO	1	1	100%		**Structure per GO**	**38**	**29**	**76%**

As illustrated in **Table 18** above, with the exception of mineral class for Air, structure length for air and water, and the structures per GO for air, all of which fall into the “Poor” category, the attributes of the 73 structures identified in the original 2010 analyses versus those identified in the inter-laboratory analyses are all within the “Good” or “Acceptable” range of the program-wide criteria (**Table 14**) specified for Mineral Class, Structure Length, Structure Width, and Structures per GO.

Table 19 - 2011 OU7/Site-wide Inter-laboratory Analyses

Results for Matched LA Structures									
Media	**Attribute**	**Total**	**Pass**	**%**	**Media**	**Attribute**	**Total**	**Pass**	**%**
Air	Mineral Class	174	165	95%	Water	Mineral Class	26	26	100%
	Structure Length	174	102	59%		Structure Length	26	18	69%
	Structure Width	174	168	97%		Structure Width	26	26	100%
	Structure per GO	77	68	88%		Structure per GO	15	15	100%
Dust	Mineral Class	50	48	96%	**Total**	**Mineral Class**	**250**	**239**	**96%**
	Structure Length	50	38	76%		**Structure Length**	**250**	**158**	**63%**
	Structure Width	50	50	100%		**Structure Width**	**250**	**244**	**98%**
	Structure per GO	14	14	100%		**Structure per GO**	**106**	**97**	**92%**

As illustrated in **Table 19** above, with the exception of the structure length for air, dust and water, which fall into the “Poor” category, the attributes of the 250 structures identified in the original 2011 analyses versus those identified in the inter-laboratory analyses are all within the “Good” or “Acceptable” range of the program-wide criteria (**Table 14**) specified for Mineral Class, Structure Length, Structure Width, and Structures per GO.

Table 20 - 2012 OU7/Site-wide Inter-laboratory Analyses

Results for Matched LA Structures									
Media	**Attribute**	**Total**	**Pass**	**%**	**Media**	**Attribute**	**Total**	**Pass**	**%**
Air	Mineral Class	88	76	86%	Water	Mineral Class	11	11	100%
	Structure Length	88	57	65%		Structure Length	11	11	100%
	Structure Width	88	84	95%		Structure Width	11	11	100%
	Structure per GO	75	58	77%		Structure per GO	9	9	100%
Soil	Mineral Class	73	71	97%	Dust	Mineral Class	11	11	100%
	Structure Length	73	54	74%		Structure Length	11	8	73%
	Structure Width	73	71	97%		Structure Width	11	11	100%
	Structure per GO	11	7	64%		Structure per GO	10	5	50%
Duff[1]	Mineral Class	0	N/A	N/A	Tree Bark	Mineral Class	116	101	87%
	Structure Length	0	N/A	N/A		Structure Length	116	88	76%
	Structure Width	0	N/A	N/A		Structure Width	116	113	97%
	Structure per GO	0	N/A	N/A		Structure per GO	18	15	83%
					Total	**Mineral Class**	**299**	**270**	**90%**
						Structure Length	**299**	**218**	**73%**
						Structure Width	**299**	**290**	**97%**
						Structure per GO	**123**	**94**	**76%**

[1]-No structures detected

As illustrated in **Table 20** above, the attributes of the 299 structures identified in the original 2012 analyses versus those identified in the inter-laboratory analyses were evaluated. The following 2012 inter-laboratory results by media and attribute were in the "Poor" category of program-wide criteria described in **Table 14**:

- Air – Mineral class, structure length, and structure per GO all fall into the "Poor" category, with respective percent pass rates of 86%, 65%, and 77%.
- Soil - Structure length and structure per GO fall into the "Poor" category, with respective percent pass rates of 74% and 64%.
- Tree bark - Mineral class, structure length, and structure per GO all fall into the "Poor" category, with respective percent pass rates of 87%, 76%, and 83%.
- Dust - Structure length and structure per GO fall into the "Poor" category, with respective percent pass rates of 73% and 50%.

All of the remaining results fall within the "Good" or "Acceptable" range of the program-wide criteria (**Table 14**) specified for Mineral Class, Structure Length, Structure Width, and Structures per GO.

2.3.2 PLM Laboratory QC

Three types of laboratory-based QC analyses were performed for samples analyzed by PLM-VE:

- Laboratory Duplicates
- Inter-laboratory Analyses
- Performance Evaluation Sample (PES) Analyses

Table 21A provides a summary of the frequency at which the inter-laboratory and laboratory duplicate analyses were performed for PLM-VE.

Table 21A PLM-VE Lab QC

			Lab Dup Cross-check (Freq. Goal=8%)		Lab Dup Self-check (Freq. Goal=2%)		Inter-laboratory (Freq. Goal=1.0%)	
Year	**Laboratory**	**Field Samples**	**LDC**	**%**	**LDS**	**%**	**IL**	**%**
2010	ESAT R8	3618	263	7.3%	77	2.1%	21	0.6%
	EMSL04	-	-	-	-	-	-	-
	EMSL19	50	4	8.0%	1	2.0%	-	-
	EMSL22	509	41	8.1%	10	2.0%	6	1.2%
	EMSL27	534	0	0.0%	40	7.5%	10	1.9%
	Reservoirs	444	22	5.0%	30	6.8%	4	1.0%
	Hygeia	481	41	8.5%	9	1.9%	4	0.8%
2011	ESAT R8	4161	352	8.5%	77	1.9%	46	1.1%
	EMSL04	-	-	-	-	-	-	-
	EMSL19	-	-	-	-	-	-	-
	EMSL22	-	-	-	-	-	-	-
	EMSL27	513	0	0.0%	56	10.9%	9	1.8%
	Reservoirs	-	-	-	-	-	-	-
	Hygeia	230	22	9.6%	3	1.3%	1	0.4%
2012	ESAT R8	4055	326	8.0%	83	2.0%	39	1.0%
	EMSL04	410	35	8.5%	10	2.4%	6	1.5%

Table 21A PLM-VE Lab QC

			Lab Dup Cross-check (Freq. Goal=8%)		Lab Dup Self-check (Freq. Goal=2%)		Inter-laboratory (Freq. Goal=1.0%)	
Year	Laboratory	Field Samples	LDC	%	LDS	%	IL	%
	EMSL19	18	0	0.0%	3	16.7%	1	5.6%
	EMSL22	378	33	8.7%	7	1.9%	7	1.9%
	EMSL27	886	62	7.0%	26	2.9%	11	1.2%
	Reservoirs	28	3	10.7%	2	7.1%	1	3.6%
	Hygeia	1377	113	8.2%	27	2.0%	14	1.0%
	Totals	**17692**	**1317**	**7.4%**	**461**	**2.6%**	**180**	**1.0%**

Although the overall program-wide QA Analysis frequencies meet or exceed the frequency requirements specified in the SOP, the laboratory duplicate analyses from some of the laboratories (highlighted in yellow) were not performed at the required frequencies. The most notable deviation was during 2010 and 2011, during which time EMSL27 failed to perform a single LDC. This deviation was brought to the attention of EMSL Analytical management and is being addressed in laboratory-specific modification LB-000094.

Table 21B provides a summary of the frequency at which the inter-laboratory and laboratory duplicate analyses were performed for PLM-GRAV.

Table 21B PLM-GRAV

			Lab Dup-Cross Check[1] (LDC) (Freq. Goal 8%)		Lab Dup Self Check[1] (LDS) (Freq. Goal 2%)		Inter-laboratory[2]	
Year	Laboratory	# Field Samples	LDC	%	LDS	%	IL	%
2010	ESAT R8	999	N/A	N/A	N/A	N/A	N/A	N/A
	EMSL22	69	N/A	N/A	N/A	N/A	N/A	N/A
	EMSL27	104	N/A	N/A	N/A	N/A	N/A	N/A
	Reservoirs	87	N/A	N/A	N/A	N/A	N/A	N/A
	Hygeia	122	N/A	N/A	N/A	N/A	N/A	N/A
2011	ESAT R8	162	N/A	N/A	N/A	N/A	N/A	N/A
	EMSL27	97	N/A	N/A	N/A	N/A	N/A	N/A
	Hygeia	3	N/A	N/A	N/A	N/A	N/A	N/A
2012	ESAT R8	460	36	7.8%	12	2.6%	3	N/A
	EMSL04	19	2	10.5%	1	5.3%	1	N/A
	EMSL19	4	2	50.0%	1	25.0%	-	-
	EMSL22	30	N/A	N/A	N/A	N/A	1	N/A
	EMSL27	124	N/A	N/A	N/A	N/A	1	N/A
	Hygeia	85	N/A	N/A	N/A	N/A	1	N/A
	Totals	**2365**	**40**	**N/A**	**14**	**N/A**	**7**	**N/A**

1-LDS and LDC were required for PLM-GRAV effective 12/6/2012 (LB-000088) and are not applicable at this time**. 2**-PLM-GRAV were introduced into the inter-laboratory program in 2012

Table 21C provides a summary of the frequency at which the laboratory duplicate analyses were reported for PLM by NIOS Method 9002.

Table 21C PLM NIOSH 9002

Year	Laboratory	# Field Samples	Lab Dup-Cross Check (LDC) (Freq. Goal 2%) LDC	%	Lab Dup Self Check (LDS) (Freq. Goal 7%) LDS	%
2010	EMSL27	1409	7	0.5%	0	0.0%
2011	EMSL27	1564	0	0.0%	0	0.0%
2012	EMSL27	1140	44	4.5%	13	1.1%
	Totals	**4113**	**51**	**1.2%**	**13**	**0.3%**

Note that, with the exception of those QC analyses performed in 2010 and 2012, the LDC and LDS quality analyses associated with the PLM NIOSH 9002 were not provided in the electronic deliverables, are not in the database, and cannot be assessed. The results of the 51 LDC and 13 LDS QC analyses from 2010 and 2012 that were provided were reviewed and determined to be 100% concordant.

2.3.2.1 Laboratory Duplicate Analyses

An laboratory duplicate analysis is a reanalysis of a sample within the same laboratory. There are two types of laboratory duplicate analyses performed for PLM-VE:

- Laboratory Duplicate Self-check (LDS) – A reanalysis of a client sample by the same analyst.
- Laboratory Duplicate Cross-check (LDC) – A reanalysis of a client sample by a different analyst.

Laboratory Duplicate Self-check (LDS)

Table 22 summarizes the results of the original and PLM-VE LDS for analyses performed in 2010. One hundred fifty (150) of the 167 original duplicate pairs (90%) were found to be in concordance. Seventeen (17) duplicate pairs (10%) were ranked as discordant; however, these results were only weakly discordant. These results would fall into the "Good" range of < 20% weakly discordant.

Table 22 - PLM-VE LDS Summary for 2010

			Lab Duplicate Results			
			Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
			A	B1	B2	C
Original Sample Results	Bin A (ND)	A	135	8	0	0
	Bin B1 (Tr)	B1	9	15	0	0
	Bin B2 (<1%)	B2	0	0	0	0
	Bin C (≥1%)	C	0	0	0	0
Total Pairs			167			
N Concordant			150			
N Weakly Discordant			17			
N Strongly Discordant			0			
Concordant			90%			
Weakly Discordant			10%			
Strongly Discordant			0%			

Table 23 summarizes the results of the original and PLM-VE LDS for analyses performed in 2011. One hundred twenty-two (122) of the 136 original duplicate pairs (90%) were found to be in concordance. Fourteen (14) duplicate pairs (10%) were ranked as discordant; however, these results were only weakly discordant. These results would fall into the "Good" range of < 20% weakly discordant.

Table 23 - PLM-VE LDS Summary for 2011

			Lab Duplicate Results			
			Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
			A	B1	B2	C
Original Sample Results	Bin A (ND)	A	101	4	0	0
	Bin B1 (Tr)	B1	10	20	0	0
	Bin B2 (<1%)	B2	0	0	1	0
	Bin C (≥1%)	C	0	0	0	0
Total Pairs			136			
N Concordant			122			
N Weakly Discordant			14			
N Strongly Discordant			0			
Concordant			90%			
Weakly Discordant			10%			
Strongly Discordant			0%			

Table 24 summarizes the results of the original and PLM-VE LDS for analyses performed in 2012. One hundred forty-nine (149) of the 158 original duplicate pairs (94%) were found to be in concordance. Nine (9) duplicate pairs (6%) were ranked as discordant; however, these results were only weakly discordant. These results would fall into the "Good" range of < 20% weakly discordant.

Table 24 - PLM-VE LDS Summary for 2012

			Lab Duplicate Results			
			Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
			A	B1	B2	C
Original Sample Results	Bin A (ND)	A	133	3	0	0
	Bin B1 (Tr)	B1	6	12	0	0
	Bin B2 (<1%)	B2	0	0	3	0
	Bin C (≥1%)	C	0	0	0	1
Total Pairs			158			
N Concordant			149			
N Weakly Discordant			9			
N Strongly Discordant			0			
Concordant			94%			
Weakly Discordant			6%			
Strongly Discordant			0%			

The increase in the percentage of concordant results for LDS analyses of 90% to 94% from 2010 to 2012 suggests both an improvement in the homogeneity of the fine ground aliquots analyzed and a consistency in the analyses by the individuals that performed both the original and LDS analysis.

In addition to the PLM-VE LDSs described above, 14 LDS PLM-GRAV analyses were performed on samples that yielded a coarse fraction, which were all ND for both the original and QC analysis.

Laboratory Duplicate Cross-check (LDC)

Table 25 summarizes the results of the original and PLM-VE LDC for analyses performed in 2010. Three hundred and sixty-four (364) of the 371 original duplicate pairs (98%) were found to be in concordance. Seven (7) duplicate pairs (2%) were ranked as discordant; however, these results were only weakly discordant. These results would fall into the "Good" range of < 20% weakly discordant.

Table 25 - PLM-VE LDC Summary for 2010

			Lab Duplicate Results			
			Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
			A	B1	B2	C
Original Sample Results	Bin A (ND)	A	197	3	0	0
	Bin B1 (Tr)	B1	4	161	0	0
	Bin B2 (<1%)	B2	0	0	6	0
	Bin C (≥1%)	C	0	0	0	0
Total Pairs			371			
N Concordant			364			
N Weakly Discordant			7			
N Strongly Discordant			0			
Concordant			98%			
Weakly Discordant			2%			
Strongly Discordant			0%			

Table 26 summarizes the results of the original and PLM-VE LDC for analyses performed in 2011. Three hundred and sixty-seven (367) of the 374 original duplicate pairs (98%) were found to be in concordance. Seven (7) duplicate pairs (2%) were ranked as discordant; however, these results were only weakly discordant.

Table 26 - PLM-VE LDC Summary for 2011

			Lab Duplicate Results			
			Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
			A	B1	B2	C
Original Sample Results	Bin A (ND)	A	147	3	0	0
	Bin B1 (Tr)	B1	4	208	0	0
	Bin B2 (<1%)	B2	0	0	8	0
	Bin C (≥1%)	C	0	0	0	4
Total Pairs			374			
N Concordant			367			
N Weakly Discordant			7			
N Strongly Discordant			0			
Concordant			98%			
Weakly Discordant			2%			
Strongly Discordant			0%			

Table 27 summarizes the results of the original and PLM-VE LDC for analyses performed in 2012. Five hundred and fifty-seven (557) of the 572 original duplicate pairs (97%) were found to be in concordance. Fifteen (15) duplicate pairs (3%) were ranked as discordant; however, these results were only weakly discordant. These results would fall into the "Good" range of < 20% weakly discordant.

Table 27 - PLM-VE LDC Summary for 2012

			Lab Duplicate Results			
			Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
			A	B1	B2	C
Original Sample Results	Bin A (ND)	A	384	5	0	0
	Bin B1 (Tr)	B1	9	157	0	0
	Bin B2 (<1%)	B2	0	1	9	0
	Bin C (≥1%)	C	0	0	0	7
Total Pairs			572			
N Concordant			557			
N Weakly Discordant			15			
N Strongly Discordant			0			
Concordant			97%			
Weakly Discordant			3%			
Strongly Discordant			0%			

The high percentage of concordant results reported for LDC analyses from 2010 through 2012 can be attributed to the fact that the same slide preparations are analyzed by both analysts.

In addition to the PLM-VE LDCs described above, 40 LDC PLM-GRAV analyses were performed on samples that yielded a coarse fraction, which were all ND for both the original and QC analysis.

2.3.2.2 PLM Inter-laboratory Analyses

Inter-laboratory samples are samples previously analyzed by one laboratory, which are selected for analysis by another laboratory. For PLM, the samples were selected in accordance with the most recent revision of laboratory modification LB-000073. Once the samples had been selected, a finely ground (FG) sample which had not been analyzed was retrieved from the sample archive of the Troy SPF and shipped blind to the laboratory scheduled to perform the inter-laboratory analysis. **Tables 28-30** provide summaries of the results from samples analyzed in 2010, 2011, and 2012 that were selected for inter-laboratory analyses.

Table 28 summarizes the results of the original and inter-laboratory analyses performed in 2010. Twenty-nine (29) of the 45 inter-laboratory pairs (64%) were found to be in concordance. Sixteen (16) inter-laboratory pairs (36%) were ranked as discordant; however, these results were only weakly discordant. These results would fall into the "acceptable" range of between 20-40% weakly discordant.

Table 28 - PLM-VE Inter-Laboratory Summary for 2010

			Inter-laboratory Results			
			Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
			A	B1	B2	C
Original Sample Results (ESAT)	Bin A (ND)	A	26	0	0	0
	Bin B1 (Tr)	B1	12	1	1	0
	Bin B2 (<1%)	B2	0	3	1	0
	Bin C (≥1%)	C	0	0	0	1
Total Pairs			45			
N Concordant			29			
N Weakly Discordant			16			
N Strongly Discordant			0			
Concordant			64%			
Weakly Discordant			36%			
Strongly Discordant			0%			

Table 29 summarizes the results of the original and inter-laboratory analyses performed in 2011. Thirty-five (35) of the 56 inter-laboratory pairs (63%) were found to be in concordance. Twenty-one (21) of inter-laboratory pairs were ranked as discordant; with 19 (34%) ranked as weakly discordant and two (4%) ranked as strongly discordant. These results would fall into the "Good" and "acceptable" range with <5% strongly discordant and between 20-40% weakly discordant, respectively.

Table 29 - PLM-VE Inter-Laboratory Summary for 2011

			Inter-laboratory Results			
			Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
			A	B1	B2	C
Original Sample Results (ESAT)	Bin A (ND)	A	33	0	0	0
	Bin B1 (Tr)	B1	16	0	1	0
	Bin B2 (<1%)	B2	1	2	1	0
	Bin C (≥1%)	C	0	1	0	1
Total Pairs			56			
N Concordant			35			
N Weakly Discordant			19			
N Strongly Discordant			2			
Concordant			63%			
Weakly Discordant			34%			
Strongly Discordant			4%			

Table 30 summarizes the results of the original and inter-laboratory samples collected in 2012. Fifty-nine (59) of the 79 inter-laboratory pairs (75%) were found to be in concordance. Twenty (20) of inter-laboratory pairs were ranked as discordant, with 18 (23%) ranked as weakly discordant and two (3%) ranked as strongly discordant. These results would fall into the "Good" and "acceptable" range with <5% strongly discordant and between 20-40% weakly discordant, respectively.

Table 30 - PLM-VE Inter-Laboratory Summary for 2012

			Inter-laboratory Results			
			Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
			A	B1	B2	C
Original Sample Results (ESAT)	Bin A (ND)	A	54	1	0	0
	Bin B1 (Tr)	B1	13	5	1	0
	Bin B2 (<1%)	B2	1	3	0	0
	Bin C (≥1%)	C	0	1	0	0
Total Pairs			79			
N Concordant			59			
N Weakly Discordant			18			
N Strongly Discordant			2			
Concordant			75%			
Weakly Discordant			23%			
Strongly Discordant			3%			

The lower percentage of concordant results for the inter-laboratory analyses versus those for the LDS and LDC analyses can be attributed to the fact that the inter-laboratory analyses are performed on separate aliquots whereas same aliquots are used for LDS and LDC. This observation is supported by the similar percentage of concordant results for the sample preparation duplicates presented in **Tables 10-12**.

In addition to the PLM-VE Inter-laboratory analyses described above, 7 PLM-GRAV inter-laboratory analyses were performed on samples that yielded a coarse fraction, which were all ND for both the original and QC analysis.

2.3.2.3 Comparison of Inter-laboratory and Original Analysis Bins

The composite PLM-VE inter-laboratory results across all laboratories for 2010, 2011, and 2012 are summarized in **Table 31**.

Table 31. Comparison of Inter-laboratory and Original Analysis Bins: Composite Results Across All Laboratories for 2010, 2011, and 2012

		Inter-laboratory Analysis Bin:				
		A	B1	B2	C	**Total**
Original Analysis Bin:	A	114	1	**0**	**0**	**115**
	B1	41	6	3	**0**	**50**
	B2	**1**	8	2	0	**11**
	C	**0**	**2**	0	2	**4**
	Total	**156**	**17**	**5**	**2**	**180**

Three key points are illustrated in **Table 31**. First, 114 of the 180 total analysis pairs (63%) were reported as Bin A (non-detected) in both the original and inter-laboratory analyses; the remaining data in **Table 31** are relatively sparse in comparison. If the concordant Bin A data are excluded, the weakly discordant data (orange shading) are more prevalent (53 pairs) than the concordant data (ten pairs, unshaded). Second, there is a strong program-wide bias for inter-laboratory reanalyses reported with lower bins than the original analyses (i.e., 50 original analyses were reported as Bin B1, but 41 of those 50 were reported as Bin A for the inter-laboratory analyses). In total, 52 inter-laboratory analyses reported lower bins than the original

analyses, while four inter-laboratory analyses reported higher bins than the original analyses. Third, only three analysis pairs are strongly discordant (red shading), representing only 1.7% of the total pairs. The program-wide goal is under 5%, therefore, placing the program-wide performance in the "Good" category.

2.3.2.4 Comparison of Average Discordance Across Individual Laboratories

Discordance comparisons have the potential to show systemic differences between laboratories. Inter-laboratory analysis average discordance results by laboratory from 2010 - 2012 are presented in **Table 32**. Shading in the table is used for the dual purposes of (1) identifying comparisons with substantial numbers of analyses, and (2) identifying comparisons with different discordance directions. Green indicates comparisons with negative average discordance (i.e., less Libby amphibole in the inter-laboratory analyses than in the original analyses). Red indicates comparisons with positive average discordance. Yellow indicates comparisons with zero average discordance. Light shades of green, red, and yellow indicate comparisons of five to nine analysis pairs. Dark shades indicate comparisons of at least ten analysis pairs. Most of **Table 32** is unshaded, due to too few analysis pairs for effective comparison. Average discordance is measured as the average difference in bin rank for analysis pairs, where bin ranks are as follows: Bin A = rank 1, Bin B1 = rank 2, Bin B2 = rank 3, and Bin C = rank 4. Thus, if three original analyses all in Bin B1 were reported for inter-laboratory analyses as one each in Bins A, B1, and C, the average discordance would be calculated as [(1-2)+(2-2)+(4-2)]÷3 = +0.33.

Table 32. Comparison of Average Discordance by Laboratory, in Numbers of Bins

Inter-laboratory Analysis (2010 – 2012)

Original Analysis	EMSL 04	EMSL 19	EMSL 22	EMSL 27	EMSL -CO	EMSL -MD	EMSL -MT	EMSL -NJ	ESAT R8	HYGEIA	RESI	Weighted Average
EMSL 04		0.00 (n=2)	0.00 (n=2)	0.00 (n=1)	(n=0)	(n=0)	(n=0)	(n=0)	0.00 (n=1)	(n=0)	(n=0)	0.00 (n=6)
EMSL 19	(n=0)		0.00 (n=1)	(n=0)	(n=0)	(n=0)	(n=0)	(n=0)	(n=0)	(n=0)	(n=0)	0.00 (n=1)
EMSL 22	(n=0)	(n=0)		-0.50 (n=2)	(n=0)	(n=0)	(n=0)	(n=0)	0.00 (n=2)	0.00 (n=1)	+0.50 (n=2)	0.00 (n=7)
EMSL 27	0.00 (n=1)	0.00 (n=2)	0.00 (n=2)		(n=0)	(n=0)	(n=0)	(n=0)	0.00 (n=2)	-1.00 (n=1)	-0.50 (n=2)	-0.20 (n=10)
EMSL -CO	(n=0)	(n=0)	(n=0)	(n=0)		0.00 (n=1)	0.00 (n=1)	-1.00 (n=1)	0.00 (n=1)	-1.00 (n=1)	0.00 (n=1)	-0.33 (n=6)
EMSL -MD	(n=0)	(n=0)	(n=0)	(n=0)	(n=0)		(n=0)	(n=0)	(n=0)	(n=0)	(n=0)	(n=0)
EMSL -MT	(n=0)	(n=0)	(n=0)	(n=0)	0.00 (n=2)	-0.50 (n=4)		-0.33 (n=3)	0.00 (n=4)	-0.50 (n=4)	0.00 (n=2)	-0.26 (n=19)
EMSL -NJ	(n=0)	(n=0)	(n=0)	(n=0)	(n=0)	(n=0)	(n=0)		(n=0)	(n=0)	(n=0)	(n=0)
ESAT R8	-0.50 (n=6)	-0.50 (n=6)	-0.33 (n=6)	-0.50 (n=6)	-0.50 (n=10)	-0.17 (n=12)	-0.40 (n=10)	-0.50 (n=12)		-0.50 (n=20)	-0.26 (n=19)	-0.40 (n=107)
HYGEIA	0.00 (n=3)	0.00 (n=3)	0.00 (n=3)	+0.33 (n=3)	0.00 (n=1)	(n=0)	0.00 (n=1)	0.00 (n=2)	0.00 (n=1)		0.00 (n=2)	+0.05 (n=19)
RESI	(n=0)	(n=0)	(n=0)	(n=0)	0.00 (n=1)	0.00 (n=1)	0.00 (n=1)	(n=0)	0.00 (n=1)	0.00 (n=1)		0.00 (n=5)
Weighted Average	-0.30 (n=10)	-0.23 (n=13)	-0.14 (n=14)	-0.25 (n=12)	-0.36 (n=14)	-0.22 (n=18)	-0.31 (n=13)	-0.44 (n=18)	0.00 (n=12)	-0.50 (n=28)	-0.18 (n=28)	-0.28 (n=180)

As stated above in the discussion for **Table 31**, on average, the inter-laboratory analyses report lower bins than the original analyses. Including all 180 inter-laboratory analysis pairs from 2010, 2011, and 2012, the magnitude of the difference is 0.28 bin ranks lower. Given the limits of the data in **Table 32**, overall generalizations for individual laboratories are substantiated only for ESATR8. Original analyses from ESATR8 dominate **Table 32**, with 107 of the 180 analysis pairs (59%). Inter-laboratory analyses of samples originally analyzed by ESATR8 have an average concordance difference of -0.40, which is more divergent than the 180-pair average of -0.28, and which suggests that the ESATR8 analyses have a bias toward higher bins relative to the other laboratories. Viewed differently, inter-laboratory analyses by ESATR8 of samples originally analyzed by other laboratories are unique in having zero average concordance difference, as opposed to the 180-pair average of -0.28. This also suggests that the ESATR8 analyses have a bias toward higher bins relative to the other laboratories. The nature of any potential high bias by ESATR8 is not discernible solely from statistical analysis of inter-laboratory data, and would require detailed evaluation of ESATR8 processes and their analytical output. The 180-pair average concordance of -0.28 may be the direct result of a large number of ESATR8 analyses with a high bias.

2.4 Performance Evaluation Sample Results

Performance Evaluation Samples (PES) are man-made samples that are prepared by "spiking" a known concentration of asbestos into a media similar to that collected in the field. Seventy (70) analyses of PLM-VE PESs were analyzed in May 2012, December 2012, and April 2013 by each of the participating laboratories. As illustrated in **Table 33** below, 53 of the 70 PES analyses were concordant (76%), 14 (20%) were weakly discordant, and 3 (4%) were strongly discordant. These results would fall into the "Good" and "acceptable" range with <5% strongly discordant and between 20-40% weakly discordant, respectively.

Table 33 – PLM-VE PES Summary for 2012

			Lab PES Results			
			Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
			A[1]	B1	B2	C
PES True Values	Bin A (ND)	A	14	0	0	0
	Bin B1 (Tr)	B1	0	5	2	0
	Bin B2 (<1%)	B2	0	4	14	3
	Bin C (≥1%)	C	0	3	5	20
Total Pairs			70			
N Concordant			53			
N Weakly Discordant			14			
N Strongly Discordant			3			
Concordant			76%			
Weakly Discordant			20%			
Strongly Discordant			4%			

[1] It should be noted that it was previously confirmed that the blank PESs distributed to the laboratories, of which there were 14, contain trace levels of "LA."

3.0 Asbestos Data Validation

Data for asbestos in air, tree bark, water, duff, sediment, soil, dust, and bulk were validated by the QATS Program in accordance with the applicable method, SAP Analytical Requirements Summaries, Laboratory Modifications, and QATS Libby-specific data validation SOPs, which

include SOP QATS-70-094 (Validation of Polarized Light Microscopy (PLM) Data Deliverables), SOP QATS-70-095 (Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables), and SOP QATS-70-096 (Validation of Phase Contrast Microscopy (PCM) Data Deliverables).

The validation process involves evaluating asbestos data based on the analytical requirements in the applicable method or SOP used by EPA for analysis of samples collected at Libby Superfund Site OUs. These include ISO 10312, AHERA, ASTM D5755, and EPA Method 100.2 for TEM, PLM-VE and PLM-GRAV for PLM analysis, and NIOSH 7400 for PCM. Criteria that are evaluated and reported include sample receipt, sample preparation, microscope alignment, instrument calibrations, stopping rules, structure recording and identification, blank analysis (if applicable), recount/re-preparation analysis (if applicable), and overall assessment of data.

Data are qualified if the daily or monthly calibrations associated with a sample set were not performed at the required frequency, or if the calibrations fail to meet method requirements. The equipment alignment and calibration documentation from each of the Libby support laboratories are provided separately on a quarterly basis. This calibration information is entered into laboratory-specific spreadsheets, where the data validators can access the information and verify that the calibrations were acceptable and performed at the correct frequency for the analyses being evaluated.

Qualifiers for blank contamination are applied during the validation process for those blanks directly associated with field samples (i.e., provided with a particular deliverable selected for validation). In addition to those QC analyses reviewed during the validation of select deliverables, QC analyses are also reviewed and evaluated on a program-wide basis to ensure they are both performed at the required frequency and that they are within the applicable criteria. With the exception of QC analyses directly associated with a particular set of samples, laboratory QC analyses are performed to determine the quality of the collective data, and not the quality of any one specific set of samples.

The data validation process also includes a comparison of the information reported on the bench sheets to the entries in the associated laboratory method-specific EDDs to ensure that the reported results are complete, compliant with the specified methodology, and accurate. These comparison discrepancies are noted in a separate table of the data validation report. A QATS Data Review Checklist is used to document the data validation process.

Selection of five percent (5%) of sample results to validate was performed by randomly choosing sample results by laboratory, method, and media. A total of 2,227 field samples (898 from 2010; 550 from 2011; and 779 from 2012) from 263 Laboratory Job Numbers, analyzed by five different laboratories between 2010 and 2012, were selected for validation. The Lab Job Numbers selected by year, laboratory, and method are listed in **Attachment 1**.

Very few Libby asbestos data were qualified. Qualifiers were applied to seven field samples and one QC sample (re-preparation), or approximately 0.31% of the 2,227 asbestos samples validated. Five field samples and one QC sample were qualified due to the failure of the laboratory to perform and/or document daily calibration activities, and two samples were qualified for field blank contamination. Several samples not associated with a daily calibration were not qualified due to the submission and review of other information suggesting acceptable instrument performance, such as spectra, daily Standard Reference Material (SRM) analysis, review of the bracketing daily alignment, evaluation of concordance between recounts or re-

preparations, or the presence of structures versus non-detected results. The samples that were qualified for lack of a daily calibration or blank contamination are listed in **Table 34** below:

Table 34 - Samples Qualified by Data Validation

Laboratory	EPA Sample ID	Lab Job No.	Date Analyzed	Method/Media	Qualifier Reason	Qualifier*
EMSL, Denver, CO	TT-12413 RP	221002018	11/11/2010	TEM-AHERA/Air	Daily Cal.	UJ
EMSL, Libby, MT	3R-02676	271101359	10/19/2011	TEM-ISO/Water	Daily Cal.	UJ
EMSL, Libby, MT	3R-02677	271101359	10/19/2011	TEM-ISO/Water	Daily Cal.	UJ
Reservoirs, Denver, CO	EX-20309	219657	11/30/2011	TEM-ISO/Air	Daily Cal.	J
Reservoirs, Denver, CO	EX-20314	219657	12/01/2011	TEM-ISO/Air	Daily Cal.	J
EMSL, Libby, MT	EX-20426	271100979	01/06/2012	TEM-ISO/Air	Daily Cal.	UJ
Reservoirs, Denver, CO	TT-12658	241059	08/02/2013	PCM-7400/Air	Field Blank	J
Reservoirs, Denver, CO	TT-12659	241059	08/02/2013	PCM-7400/Air	Field Blank	J

*J - The result (concentration) is estimated.

*UJ - The non-detect result may be inaccurate or imprecise.

In total, 2,416 sample analyses were validated, including 2,126 field samples, 101 field blanks, 27 laboratory blanks, and 162 QC samples. The blanks and QC samples are listed by type and analysis year in **Table 35** below:

Table 35 – Number of Blanks and QC Samples Validated

QC Type	Analysis Year			
Blank/QC Sample Type	2010	2011	2012	Total
Laboratory Blanks	10	4	13	27
Field Blanks	59	15	27	101
Recount Same (RS)	5	1	3	9
Recount Different (RD)	9	3	8	20
Re-preparation (RP)	1	1	3	5
Verified Analysis (VA)	2	1	1	4
Lab Duplicate Self-check (LDS)	17	2	15	34
Lab Duplicate Cross-check (LDC)	30	25	35	90

From the 2,416 field samples, QC samples, and blanks validated, the results from seven field samples and one QC sample were qualified (see **Table 34**).

The bench sheet/EDD information comparisons did reveal discrepancies due to information omissions and typographical errors, which were reported in the EDD/Bench Sheet Discrepancy Table in the Asbestos Validation Summary Reports. The discrepancies ranged from minor (i.e., typographical errors or omissions in fields that do not affect the sample results) to more severe discrepancies (i.e., typographical errors for air volume and minimum aspect ratio which could affect the sample result, or date analyzed discrepancies which could affect the daily calibration verification). Of the 2,227 sample results validated 254 (11.4%) contained some type of bench sheet/EDD discrepancy. However, 249 of these 254 (98%) were minor typographical discrepancies. Two discrepancies affecting five samples (listed below in parentheses) could potentially affect the sample results. These five samples include: sample 1-09624 (EMSL-NJ, samples EX-10263 and EX-20422 (EMSL-MT); and samples TB-00391 and TB-00392 (RESI). Incorrect air volumes were entered into the EDD file for three samples and an incorrect

minimum aspect ratio was entered into the EDD file for two samples. **Table 36** shows the number of discrepancies found in the EDD files submitted by laboratory and the analysis year.

Table 36 - Number of Discrepancies Listed in the EDD/Bench Sheet Discrepancy Table

Laboratory	2010	2011	2012	Totals
EMSL, New Jersey	NA	0	33 (1)	**33**
EMSL, Beltsville, MD	0	1	1	**2**
EMSL, Denver, CO	0	6	5	**11**
EMSL, Libby, MT	40 (1)	17	23 (1)	**80**
Hygeia Environmental	64	21	17	**102**
Reservoirs Environmental	2	9 (2)	12	**23**
ESAT Region 8	1	0	2	**3**
Total Discrepancies	**107**	**54**	**93**	**254**
Total Samples Validated	**898**	**550**	**779**	**2227**

NA indicates that no samples from the laboratory were validated for that year.

4.0 Laboratory On-site Audits

This section includes a summary of the results of on-site audits of laboratories and soil preparation facilities used by EPA for analytical support at the Libby Superfund Site that were conducted in 2008 and 2012. During this period, a total of 15 on-site audits were performed, including 13 asbestos laboratory audits and two asbestos soil preparation facility audits. **Table 37** lists the audits performed by laboratory/facility, audit type, and date.

Table 37 - Asbestos Laboratory and Soil Preparation Facility On-site Audits

Laboratory	Audit Type	Audit Date(s)
EMSL Analytical, Inc. (Denver, CO)	Asbestos Laboratory	05/21-22/2012
ESAT Region 8 Laboratory (Golden, CO)	Asbestos Laboratory	05/22-23/2012
EMSL Analytical, Inc. (Westmont, NJ) 1	Asbestos Laboratory	06/26-27/2012
EMSL Analytical, Inc. (Beltsville, MD)	Asbestos Laboratory	06/28-29/2012
Hygeia Environmental, Inc. (Sierra Madre, CA)	Asbestos Laboratory	07/25-26/2012
ESAT Region 8 Soil Preparation Facility (Troy, MT)	Soil Preparation Facility	08/07/2012
EMSL Analytical, Inc. (Libby, MT)	Asbestos Laboratory	08/08-09/2012
Reservoir Environmental, Inc. (Denver, CO)	Asbestos Laboratory	09/12-13/2012
EMSL Analytical, Inc. (Westmont, NJ) [1]	Asbestos Laboratory	04/23-24/2008
EMSL Analytical, Inc. (Beltsville, MD)	Asbestos Laboratory	05/13-14/2008
Hygeia Environmental, Inc. (Sierra Madre, CA)	Asbestos Laboratory	06/25-26/2008
EMSL Analytical, Inc. (Libby, MT)	Asbestos Laboratory	09/16-17/2008
ESAT Region 8 Soil Preparation Facility (Troy, MT)	Soil Preparation Facility	09/18/2008
Reservoir Environmental, Inc. (Denver, CO)	Asbestos Laboratory	09/30-10/01/2008
ESAT Region 8 Laboratory (Golden, CO)	Asbestos Laboratory	10/27/2008

[1] This laboratory is now located in Cinnaminson, NJ

4.1 On-site Audit Process

On-site audits are used by EPA to verify that samples analyzed by their contract facilities are being processed in accordance with EPA requirements. Each on-site audit involves the general elements of preparation, on-site support, and report generation, which are modified as needed to fit the type of audit being performed. Preparation for asbestos laboratory audits typically

involves ensuring the on-site audit checklist to be used is updated to reflect the latest methods and modifications required for Libby sample preparation and analysis; coordination with Region 8 to receive the most recent copies of the laboratory's SOPs, Quality Assurance Manual (QAM) and other needed documentation; and coordination with the EPA representative attending the audit with regard to travel logistics. If there are any anticipated problem areas based on prior evaluation of QA/QC data or validation reports, the auditor will discuss these with the EPA member of the Audit Team prior to the audit. The on-site audit generally starts with an entrance debriefing to the laboratory regarding what areas will be evaluated and the anticipated duration of the audit. This is followed by evaluating areas throughout the laboratory to verify adherence to Libby project analysis requirements, the laboratory preparation and analysis SOPs, and adherence to the requirements in the laboratory QAM. The areas typically audited in an asbestos laboratory include Sample Receipt, Log-in, Storage, and Chain-of-Custody (COC) procedures; Indirect and Direct Preparation of Samples; Transmission Electron Microscopy (TEM) Analysis; Polarized Light Microscopy (PLM) Analysis; and Quality Control and Quality Assurance. All laboratory staff involved with handling, preparing, analyzing, reporting, and performing QC on Libby samples are interviewed. Findings are identified, and reported to the laboratory at the exit debriefing. On-site audit reports detailing the findings are prepared and submitted to EPA typically within a month, and following EPA approval are sent to the laboratories, which are required to provide corrective action response to EPA regarding the findings. Areas where findings were identified are evaluated during the next on-site audit to determine the degree to which laboratories have applied corrective action.

The results from the above-listed 13 analytical support laboratory on-site audits are summarized below in the following categories:

- Deficiencies by Laboratory
- Laboratory Trends
- Deficiencies by Laboratory Process Area
- Laboratory Responses
- Soil Preparation Facility (SPF) Audits
- Laboratory Internal Audits
- Air Monitoring Samples

4.2 Deficiencies by Laboratory

A total of 66 deficiencies, compiled from the completed summary on-site audit reports, were identified from the seven laboratory on-site audits performed in 2012. Deficiencies from the soil preparation facility (SPF) audit (SPF-MT) are not included in this total because it did not involve the preparation and analysis of asbestos samples. The results from the SPF on-site audit is discussed separately in **Section 5.6**. Of the seven laboratory audits, one laboratory (EMSL Analytical, Denver, CO) was a new laboratory audited for the first time. For the laboratory audits conducted in 2012, an average of 9.4 deficiencies per audit was observed. The laboratory with the lowest number of deficiencies per audit were Reservoir Environmental Services, Inc. with six deficiencies, and EMSL-NJ with seven deficiencies. The laboratory with the highest number of deficiencies per on-site audit were EMSL-CO with 15 deficiencies, and ESAT Region 8 with 11. The deficiency totals, by laboratory, for all on-site audits are provided in **Table 38**.

Table 38 – Asbestos On-Site Audit Deficiencies by Laboratory (2012)

Laboratory	Year	Total Deficiencies	Percentage
EMSL Analytical, Inc. (Denver, CO)	2012	15	22.7%
ESAT Region 8 Laboratory (Golden, CO)	2012	11	16.7%
EMSL Analytical, Inc. (Westmont, NJ)	2012	7	10.6%
EMSL Analytical, Inc. (Beltsville, MD)	2012	8	12.1%
Hygeia Environmental, Inc. (Sierra Madre, CA)	2012	10	15.2%
EMSL Analytical, Inc. (Libby, MT)	2012	9	13.6%
Reservoir Environmental, Inc. (Denver, CO)	2012	6	9.1%
Total		**66**	**100%**
Average		**9.4**	

4.3 Laboratory Trends

A deficiency comparison between the 2008 on-site audits and the same laboratories audited in 2012 was performed to determine corrective action trends. A total of 51 deficiencies were identified in the six asbestos on-site laboratory audits performed during 2012, as compared to the 93 defects observed in the on-site audits of the same six laboratories in 2008 **(**see **Table 39)**. Note that seven asbestos laboratory on-site audits were performed in 2012 (with 66 total defects observed). The average of 9.4 defects per on-site audit in 2012 represents a 39.4% decrease from the 15.5 average number of defects per on-site audit (for the same six laboratories) recorded in 2008. All six laboratories audited in 2008 and again in 2012 showed a significant reduction in the number of defects, which suggests that all six laboratories applied corrective action in response to their initial audits in 2008.

Table 39 – Asbestos On-Site Audit Deficiencies by Laboratory (2008)

Laboratory	Year	Total Deficiencies	Percentage
EMSL Analytical, Inc. (Westmont, NJ)	2008	17	18.3%
EMSL Analytical, Inc. (Beltsville, MD)	2008	12	12.9%
Hygeia Environmental, Inc. (Sierra Madre, CA)	2008	19	20.4%
EMSL Analytical, Inc. (Libby, MT)	2008	15	16.1%
Reservoir Environmental, Inc. (Denver, CO)	2008	10	10.8%
ESAT Region 8 Laboratory (Golden, CO)	2008	20	21.5%
Total		**93**	**100%**
Average		**15.5**	

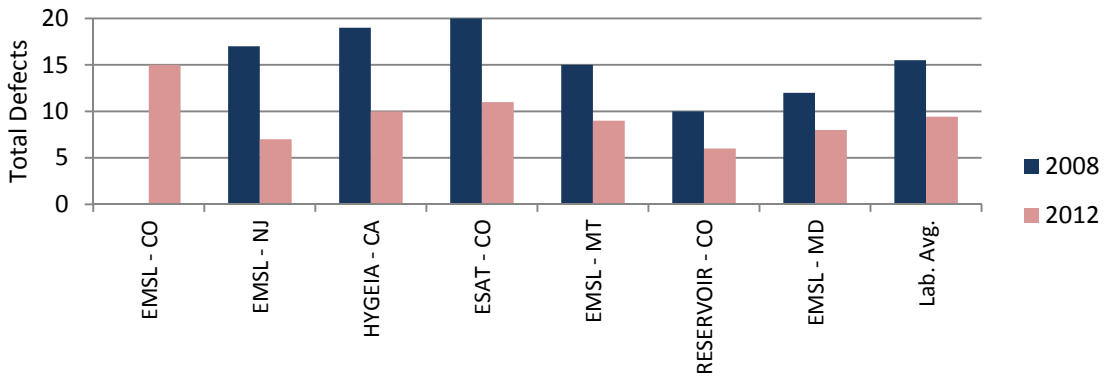
The percent change (decrease or increase) in total defects from one on-site audit to the next can be a useful indicator of laboratory performance and/or applied corrective action. As shown in **Table 40**, the percent change in defects between the six laboratories audited in 2008 to 2012 include EMSL Analytical, Inc. (Westmont, NJ (-58.8%), Hygeia Environmental, Inc. (Sierra Madre, CA) (-47.4%), ESAT Region 8 Laboratory (Golden, CO) (-45.0%), EMSL Analytical, Inc. (Libby, MT) (-40.0%), Reservoir Environmental Services (Denver, CO) (-40.0%), and EMSL Analytical, Inc. (Beltsville, MD) (-33.3%).

Table 40 – Deficiencies by Laboratory (2008 - 2012)

Laboratory	Deficiencies			Change In Defects per Audit	
	2008	2012	AVG	Increase/ (Decrease)	%Increase/ (%Decrease)
EMSL Analytical, Inc. (Denver, CO)		15	15	NA	NA
EMSL Analytical, Inc. (Westmont, NJ)	17	7	11.5	(10)	(58.8%)
Hygeia Environmental, Inc. (Sierra Madre, CA)	19	10	14.5	(9)	(47.4%)
ESAT Region 8 Laboratory (Golden, CO)	20	11	15.5	(9)	(45.0%)
EMSL Analytical, Inc. (Libby, MT)	15	9	12	(6)	(40.0%)
Reservoir Environmental, Inc. (Denver, CO)	10	6	8	(4)	(40.0%)
EMSL Analytical, Inc. (Beltsville, MD)	12	8	10	(4)	(33.3%)
Total	**93**	**66**		**(27)**	**(29.0%)**
Average	**15.5**	**9.4**		**(6.1)**	**(39.4%)**

Figure 1 shows the on-site audit defect trends by laboratory for the laboratories audited in 2008 and again in 2012 (with the exception of EMSL-CO).

Figure 1 – Asbestos On-site Audit Trends: Total Defects by Laboratory (2008-2012)



4.4 Deficiencies by Laboratory Process Area

The 66 asbestos on-site audit deficiencies identified in the seven on-site laboratory audits performed in 2012 were trended by six laboratory process areas. The laboratory process categories in which the majority of the observed deficiencies occurred include PLM, Sample Preparation, and QC/QA. Categories with the least frequently occurring deficiencies included Sample Receiving, TEM, and Data Management.

Table 41 and **Figure 2** show the laboratory process categories evaluated, the number of deficiencies observed in each from the 2012 on-site audits, and the percentage of deficiencies observed by category.

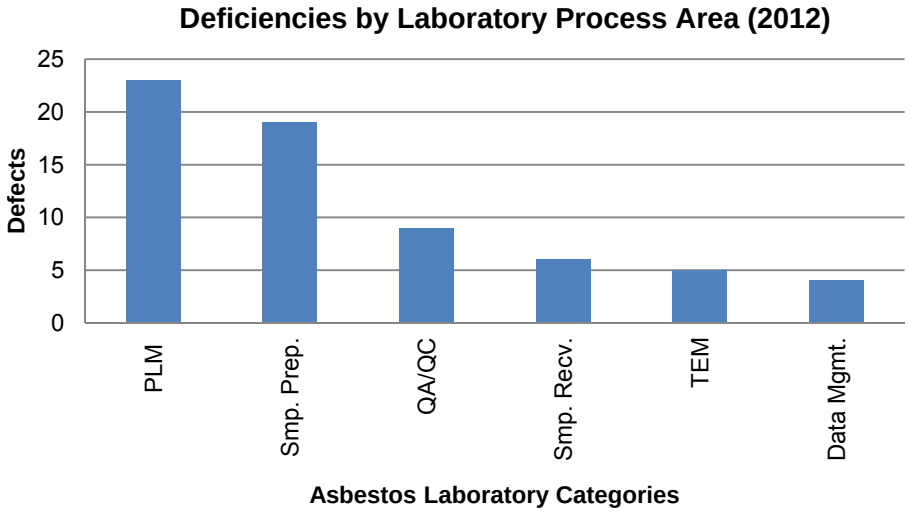
Table 41 - On-site Laboratory Audit Deficiencies by Laboratory Process Area - 2012

Laboratory Area	Deficiencies	Percentage
PLM Analysis	23	34.8%
Sample Preparation	19	28.8%
QC/QA	9	13.6%
Sample Receiving	6	9.1%

Table 41 - On-site Laboratory Audit Deficiencies by Laboratory Process Area - 2012

Laboratory Area	Deficiencies	Percentage
TEM Analysis	5	7.6%
Data Management	4	6.1%
Total	**66**	**100%**

Figure 2 – Asbestos On-site Audit Trends: Deficiencies by Laboratory Area (2012)



Examples of high frequency deficiencies by laboratory process category that were observed in the seven on-site audits performed in 2012 are summarized as follows:

Polarized Light Microscopy (PLM) Analysis - In four of the seven laboratories audited in 2012, the Laboratory Duplicate Cross-check (LDC) optical property observations were being recorded on the same bench sheet as the observations for the original (first) analysis, and therefore were not “blind”. This has since been discussed with the laboratories and corrected. In four of the laboratories, the procedure used for performing the PLM analysis of finely ground soil samples did not comply with the procedure described in SOP SRC-Libby-03 in that suspect fibers were picked out after, rather than prior to preparing the five random slide mounts. In three of the laboratories, the permanently mounted LA reference slides of 0.2% and 1.0% were not prepared “in-house,” but by one of the other Libby laboratories.

Indirect and Direct Preparation of Air Filter and Dust Samples - Three of the seven laboratories audited in 2012 had deficiencies related to balance calibrations, including failure to perform daily calibration checks of balances used to weigh samples, and failure to use an outside service for annual balance calibrations. In two of the laboratories, the Effective Filtration Area (EFA) of the disposable filter assembly was not being determined for each lot of filters received.

Sample Receipt, Storage, Log-in, and COC - Two of the seven laboratories audited in 2012 did not have HEPA hoods in the sample receiving area (EMSL-Denver), or they were not properly identified to allow flow checks and HEPA filter changes to be documented (EMSL-MD). Two laboratories had no defects in this category (ESAT-CO and Reservoir).

Quality Control and Quality Assurance - Several of the laboratories audited in 2012 did not always implement or maintain adequate quality systems. EMSL-MT did not perform internal audits at the required frequency, EMSL-NJ did not have an adequate quality system in place to track corrective actions, and Hygeia did not control obsolete documents including QAMs and SOPs. Two laboratories did not adequately perform air monitoring, including EMSL-MD which did not always perform cleanups and re-sampling in response to internally or externally-identified asbestos contamination, and Hygeia did not perform air monitoring of the analytical areas at the frequency described in their written procedures.

Transmission Electron Microscopy (TEM) Analysis - There were no common deficiencies in TEM analysis identified in the 2012 on-site audits. Two laboratories had no defects in this category, while the other five each had one deficiency related to documentation, availability of lab modification, or the availability of instrument LA reference spectra.

Data Management - There were no common deficiencies in Data Management identified in the 2012 on-site audits. Four of the seven laboratories had no deficiencies in this category. Deficiencies related to record-keeping and availability of all required procedures were observed in the EMSL-MD, EMSL-CO, and Reservoir audits.

Fiber Analysis by Phase Contrast Microscopy (PCM) - There were no PCM-related deficiencies identified in the 2012 on-site audits. All 2008 deficiencies in this category had been corrected.

Facilities - There were no facility-related deficiencies identified in the 2012 on-site audits.

4.5 Laboratory Responses

EPA requires that laboratories provide responses to on-site audit reports which include the laboratory's proposed corrective action to each of the identified findings. These laboratory responses assist EPA in "closing the loop" on laboratory deficiencies, and help resolve method interpretation issues. Laboratory responses to all reports for the 2008 and 2012 on-site audits have been received from the support laboratories. All laboratories provided proposed corrective actions for the identified findings, along with objective evidence as applicable. No findings were contested. These laboratory-proposed corrective actions in response to the 2012 audits will be verified during the next round of scheduled audits. As shown in **Table 38**, the average number of findings per on-site audit of the support laboratories decreased by 39.4%, from 15.5 to 9.4 defects/audit between 2008 and 2012, suggesting that corrective action has been performed in response to previous audit findings.

4.6 Soil Preparation Facility (SPF) Audits

In 2012, QATS supported one soil preparation facility on-site audit. The ESAT Region 8 SPF in Troy, MT was a follow-up audit to the audit performed in 2008.

4.6.1 Deficiencies by SPF

A total of 18 deficiencies, compiled from the completed summary on-site audit reports, were identified from the two soil preparation facility on-site audits performed at ESAT Region 8 SPF in Troy, MT in 2008 and 2012. An average of 9.0 deficiencies per audit was observed. The deficiency totals, by facility, are provided in **Table 43**.

Table 43 - SPF On-Site Audit Deficiencies by Facility (2008 and 2012)

Soil Preparation Facility	Deficiencies			Change In Defects per Audit	
	2008	2012	AVG	Increase/ (Decrease)	%Increase/ (%Decrease)
ESAT Region 8 Soil Prep. Facility (Troy, MT)	8	10	9	2	25.0%
Total	**8**	**10**			
Average	**8**	**10**		**(2)**	**(25.0%)**

4.6.2 SPF On-site Audit Trends

The 18 on-site audit deficiencies identified in the two soil preparation facility on-site audits were trended by eight facility process areas. The process categories in which the majority of the observed deficiencies occurred include Bulk Drying and Grinding and Splitting. Categories with the least frequently occurring deficiencies included Sample Receiving, Facility, Sieving of Preparation Samples, Soil Preparation, and Health and Safety.

Table 44 shows the facility process categories evaluated, the number of deficiencies observed in each from the combined 2008 and 2012 on-site audits, and the percentage of deficiencies observed by category.

Table 44 - SPF On-site Audit Deficiencies by Process Area - 2008 to 2012

Laboratory Area	Deficiencies			
	SPF 2012	SPF 2008	Total	Percentage
Bulk Drying	3	2	5	27.8%
Grinding and Splitting	3	2	5	27.8%
QC/QA	2	1	3	16.7%
Sample Receiving	1	0	1	5.6%
Facility	0	1	1	5.6%
Sieving of Preparation Samples	1	0	1	5.6%
Sample Preparation	0	1	1	5.6%
Health and Safety	0	1	1	5.6%
Total	**10**	**8**	**18**	**100%**

Ten deficiencies were identified in the ESAT Region 8 SPF on-site audit performed in 2012 as compared to the eight defects observed at the same facility in 2008. This represents a 25.0% increase from the 2008 audit. This increase is due mainly to one additional deficiency each in the bulk drying, grinding and splitting, QA/QC, sample receiving, and sieving categories. Decreases were observed in the facility, sample preparation, and health and safety categories.

4.7 Laboratory Internal Audits

Each of EPA's Libby asbestos support laboratories has an internal audit program in place, and conducts internal audits of their specific operations on an annual basis using standardized checklists. During the external EPA on-site laboratory audits, the Audit Team reviews with the laboratory staff any significant findings noted in their internal audit reports. **Table 45** shows the internal audit history from 2010 to 2012 of the seven laboratories that currently provide support to Libby Superfund Site analytical activities.

Table 45 - Internal Audit History for OU3 Support Laboratories (2010 - 2012)

Laboratory	2010	2011	2012
EMSL-Westmont	4/27-29/2010	7/7-8/2011	None
EMSL-Denver	3/31/2010	3/23-25/2011	10/30/2012
EMSL-Beltsville	12-21-22/2010	12/15-16/2011	12/19-20/2012
EMSL-Libby	1/14-15/2010	1/12/2011	9/24-25/2012
Hygeia	7/14-15/2010	8/15-16/2011	9/24-28/2012
ESAT Region 8	12/12/2010	11/23/2011	8/10/2012
Reservoirs	None	3/26-31/2011	3/23/2012

4.8 Air Monitoring Samples

An environmental contamination air monitoring program is required at each of the EPA support laboratories that analyze samples from Libby. Specifics regarding the requirements of the laboratory monitoring program for each laboratory are described in the laboratory specific QA Management Plans (QMPs). All QMPs require that the laboratory Quality Assurance Manager (QAM) immediately contact the Laboratory Coordinator (LC) and the QATS contractor regarding any laboratory contamination monitoring results that are outside of the required acceptance criteria.

In 2012, the air monitoring program at the EMSL laboratory in Libby, Montana yielded two results that were outside the acceptance criteria. Between April 20, 2010 to December 12, 2012, 112 air monitoring samples were collected at this laboratory. Samples were collected at various locations throughout the laboratory, including the transmission electron microscope laboratory, the polarized light microscopy laboratory, and the reception area. Of the 112 air monitoring samples collected, there were two (2) outliers which are described below:

- July, 20, 2012 – One sample collected from the PLM room contained one (1) LA structure, which can be considered a minor level contamination. The laboratory initiated appropriate corrective action, which included re-cleaning and re-sampling the area.

- September 20, 2012 – One sample collected in one of the TEM rooms contained two (2) chrysotile structures. Since chrysotile is not an analyte of interest and the levels did not exceed NVLAP criteria, no further action was necessary.

5.0 Laboratory Mentoring Program

To ensure that new laboratories have properly trained staff to perform analysis of Libby site samples, a program was established in which laboratories and/or analysts who are experienced with the analysis of LA provide training and mentoring to new laboratories prior to the receipt and analysis of Libby field samples. The new laboratory training program includes a rigorous 2-3 day period of on-site training provided by senior personnel from those laboratories who are highly experienced with the Libby project. Training includes a review of morphological, optical, chemical, and electron diffraction characteristics of LA, as well as training on the project-specific analytical methodology, documentation, and administrative procedures required for the Libby site. No new laboratories were mentored from 2010 through 2012.

For those laboratories and analysts already analyzing samples from the Libby site, the following reference materials, EDD tools, SOPs, laboratory modification, and meeting participation are in place to ensure consistency and continued training:

Site-specific Reference materials

- TEM - Because LA is not a common form of asbestos, USGS prepared site-specific reference materials using LA collected at the Libby mine site (EPA 2008a), which each laboratory must analyze in order to become familiar with the physical and chemical appearance of LA and establish a reference library of instrument-specific LA EDS spectra.

- PLM - USGS has also prepared site-specific reference materials of LA in soil for use during PLM-VE analyses, which are mounted on slides at concentrations of 0.2% and 1.0% by weight and used to assist in determining visual area estimation of LA levels in soil.

Regular Technical Discussions

To ensure that all laboratories are aware of technical or procedural issues and requirements, monthly teleconference calls are held between EPA, their contractors, and each of the participating laboratories. These calls cover all aspects of the analytical process, including sample flow, information processing, technical issues, analytical method procedures and development, documentation issues, project-specific laboratory modifications, and pertinent asbestos publications.

Data Recording

Standardized data entry spreadsheets (electronic data deliverables, or EDDs) have been developed specifically for the Libby project to ensure consistency between laboratories in the presentation and submittal of analytical data. In general, a unique Libby-specific EDD was developed for each type of analytical method. Each EDD contains a variety of built-in QC functions that improve the accuracy of data entry and help maintain data integrity.

Laboratory Modification Forms

When changes or revisions are needed to improve or document specifics about analytical methods or procedures used by the Libby laboratory team, these changes are documented using laboratory modification forms, which provide a standardized format for tracking procedural changes in sample analysis, allowing project managers to assess potential impacts on the quality of the data being collected. A list of current, active modifications is provided in Section 6.0.

6.0 Laboratory Modifications

Thirteen (13) project-specific laboratory modifications were developed and/or reviewed. Listed below are summary descriptions and revision dates of each laboratory modification.

a) LB-000015A (Revised 9/24/2012) – This modification documents permanent modifications and clarifications to the Phase Contrast Microscopy (PCM) analysis of air samples using the NIOSH 7400 Method.

b) LB-000016H (Revised 9/25/2012) – This modification documents permanent modifications and clarifications to TEM structure recording rules for ISO 10312, and documents previous historical modifications and clarifications. This modification applies

to all Libby TEM samples where the ISO 10312 counting rules apply, regardless of sample matrix (air, dust, water, woodchip/duff, tree bark, and tissue samples).

c) LB-000020B (Revised 3/19/2012) – This modification applies to the preparation and analysis of water samples for the Libby Project. As of 07/27/2010, it requires all water samples associated with the Libby Superfund Site to undergo treatment with ozone/UV light and sonication prior to filtration as specified in Section 6.2 of EPA Method 100.1 (EPA 1983a). Only polycarbonate (PC) or mixed cellulose ester (MCE) filters with a pore size of 0.2 µm or smaller should be used for filtering water samples. On the bench sheets, the preparation date should be recorded as the filtration date, not the grid preparation date. Recording rules will be as described in the ISO 10312 (ISO 1995) method, except that the aspect ratio and minimum length requirements will be specified in the applicable governing Analytical Requirements Summary Sheet.

d) LB-000029D (Revised 3/12/2013) – This modification provides permanent clarifications to laboratory-based quality control (QC) analysis requirements for TEM. The purpose is to standardize the frequency of analysis and procedures for the selection and interpretation of the results for laboratory-based TEM QC analyses (regardless of sample medium).

e) LB-000031G (Revised 4/30/2012) – This revision combines the modifications described in LB-000017, LB-000017A, LB-000031, and LB-000031A into one summary of the permanent modifications to the TEM structure recording rules for air samples by AHERA and dust samples by ASTM D5755. The purpose of the modification is to document historic modifications and clarifications and provide additional, permanent clarifications.

f) LB-000040A (Revised 1/25/2012) – This modification documents the requirements for project documents and analytical results to utilize ASTM D5755-09 in replacement of ASTM D5755-03.

g) LB-000055B (Revised 11/2/2012) – This purpose of this laboratory modification is to address sample collection procedures for the Outdoor Ambient Air Monitoring Programs for the Libby Asbestos Superfund Site, including the ambient air programs for Operable Unit 4 (OU4) and OU7 (Troy). Due to meteorological conditions prevalent in Libby in the late fall (e.g., fog, inversions, other potential precipitation), the collected air filters have the potential to arrive at the laboratory in a damp condition. To allow these samples to be properly prepared for TEM analysis and to prevent subsequent biological growth, this modification requires all ambient air samples to be dried upon receipt at the on-site laboratory (e.g., EMSL-Libby), prior to further preparation/analysis at the on-site laboratory, or prior to transfer to another laboratory for further preparation/analysis.

h) LB-000066D (Revised 7/2/2010) – This permanent modification applies to all Libby site investigative samples as defined by in the relevant SAPs and analyzed by TEM. This modification does not apply to non-investigative samples. Based on this modification, all analytical laboratories shall: 1) indicate on the count sheet the presence or absence of sodium and potassium in all recorded structures (except chrysotile); 2) record on the count sheet “close-call” NAM particles; 3) record the probable mineral species of each recorded structure; 4) record EDS spectra of “LA” and “close-call” NAM particles; and 5) record 1 photomicrograph of a SAED (selected area electron diffraction) pattern for each “LA” or “OA” amphibole type encountered in a sample.

i) LB-000067C (Revised 4/1/2013) – This modification provides direction on how to improve consistency in the recording and reporting of structures for all TEM methods for the Libby Project. It also consolidates the three modifications applicable to all TEM methods into a single modification.

j) LB-000073C (Revised 12/6/2012) – This modification provides permanent clarifications to inter-laboratory analyses for the Libby-specific PLM-VE (SRC-LIBBY-03) and PLM-Gravimetric (SRC-LIBBY-01) methods, and standardizes the selection and analysis procedures for inter-laboratory soil samples.

k) LB-000085A (Revised 5/4/2012) – The purpose of this modification is to standardize the frequencies and performance criteria of instrument calibrations at all TEM laboratories that analyze samples for the Libby Project. Contamination monitoring by air sampling at the labs is also described in this modification.

l) LB-000087 (Revised 5/4/2012) – This modification documents clarification of the PLM NIOSH Method 9002 asbestos mineral identification criteria as applied to the identification of tremolite-actinolite, and its presence as "LA" in soils collected from the Libby Superfund Site. It also describes the historical recording and reporting of tremolite-actinolite and "LA", respectively, in samples analyzed by NIOSH Method 9002 prior to 03/14/2012; how the Scribe database will be updated to address the described inconsistencies; and how samples identified as containing tremolite-actinolite by this method will be qualified to document their inclusion in "LA" solid solution series in all future deliverables.

m) LB-000088 (Revised 12/17/2012) – This modification documents the effective dates on which the project soil preparation facility (SPF) and analytical laboratories are to adhere to SOPs ISSI-Libby-01, SRC-Libby-03, and SRC-Libby-01 when performing PLM-VE, Gravimetric analysis, or particle size reduction.

7.0 Conclusions and Recommendations

7.1 Field Quality Control Samples

Collection Frequency

The collection frequency of field QC samples, which includes field blanks, rinsate blanks, lot blanks, and field duplicates, are summarized in **Table 2**. Most appear to have been collected at the proper frequency. Two examples of exceptions are as follows:

- For dust samples with the prefix "TT-" collected in 2010, 2011 and 2012, and analyzed by ASTM Method D5755, field duplicates were not collected at the frequency of 1 per 20 samples (5%) specified in the applicable SAP.

- For soil samples with the prefix "EX-" collected in 2011 and analyzed by ISO Method 10312, field duplicates were not collected at the frequency of 1 per 20 samples (5%) specified in the applicable SAP.

It should also be noted that it wasn't possible to assess if the number of field QC samples collected and/or analyzed were adequate because the requirement was not strictly based on an overall percent requirement. An example of this would be for samples with the prefix "NE-",

which states that water field blanks be collected at a rate of one per field team per day, with only one of these selected at random per week for analysis.

Field QC Discordances

With the exception of the following two PCM field blanks and one TEM field duplicate, all of the field QC samples collected from 2010 through 2012 were within the established criteria:

- Two PCM field blanks contained greater than the allowed limit of 7 fibers per 100 graticule fields, and should be qualified as estimated (J). These samples, along with associated samples, are summarized in **Table 4**.

- One TEM field duplicate, identified in **Table 5**, failed the Poisson ratio test using a 90% confidence interval.

In order to ensure all field QC samples are collected at the proper frequency and in a manner that minimizes cross contamination, QATS would recommend that field audits be conducted at the beginning of select sampling scenarios.

7.2 SPF QC Samples

Preparation QC samples collected at the Troy Soil Preparation Facility (SPF), which include preparation duplicates, grinding blanks, and drying blanks, were performed at the correct frequency. Only one of the 909 preparation duplicates prepared (<1%) had a result that was strongly discordant from its duplicate. The overall percentage of weakly discordant results was 24%. The QATS Audit Team will evaluate the splitting process during the 2014 scheduled on-site audit to determine whether this process can be improved to reduce this percentage of discordance results.

7.3 Laboratory QC Analyses

7.3.1 Transmission Electron Microscopy

QC Frequency

As illustrated in **Table 13**, most of the program-wide QC sample frequency was consistent with the requirements described in Laboratory modification LB-000029D. However, this does not include re-preparations, which were only prepared at an overall frequency of 0.6%. In addition, on an individual laboratory basis, most laboratories fall short of the required frequencies for re-preparations, laboratory blanks, and recounts. One contributing factor is that some of the laboratories didn't receive sufficient samples to trigger the requirement to perform QC Analyses. To correct this, QATS recommends that QC analyses be performed on the first sample, as opposed to the last. Instead of performing a re-preparation on the 100th sample (1%) one would be performed on the 1st and 101$^{st.}$, which would assure adequate QC analyses are performed.

Laboratory QC Discordances

Overall the intra-laboratory analyses (i.e. RS, RD, RP and VA) fell into the "Good" and "Acceptable" range described in the **Table 14,** the exception being the mineral class criteria, which fell into the "Poor" category for the air, soil, and water samples on which recounts were performed in 2012.

The results of the inter-laboratory analyses were not as encouraging with many of the results falling into the "Poor" category. This suggests that although consistency has been achieved at the laboratory level, there is still work to do before that same level of consistency is achieved between laboratories. In order to achieve this goal QATS recommends increasing the frequency at which TEM inter-labs are currently performed from annually to at least semi-annually, and possibly increasing the inter-laboratory analysis percentage from 0.5% of the samples analyzed to 1%.

7.3.2 Polarized Light Microscopy

QC Frequency

As illustrated in **Table 21A**, the program-wide PLM QC frequency was consistent with the requirements described in the PLM-VE SOP. However, on an individual laboratory basis, this was not always the case, with two laboratories consistently not meeting the 8% frequency requirement for LDC analyses. One of the laboratories had not performed an LDC in either 2010 or 2011, and also fell short for 2012. In all this particular laboratory had analyzed 1933 samples but only performed 61 LDCs, resulting in a QC frequency percentage of 3.2%, well below the required 8%. In response, this laboratory was required by EPA to complete a laboratory-specific modification (LB-000094) to describe the deviation from the SOP, and describe what steps will be taken to prevent a similar occurrence in the future. Concerning the analytical QC requirements for PLM-GRAV, these requirements did not become effective until December 6, 2012, but will be monitored to ensure compliance.

Laboratory QC Discordances

With the exception of a few outliers, the LDC, LDS and PLM Inter-laboratory analyses fell into the concordant or weakly discordant categories, weakly discordant being those values that are within one bin category (i.e. A versus B1). However, there were some procedural inconsistencies between laboratories identified during the on-site audits that could be contributing to the percentage of weakly discordant results. These include:

- Stereomicroscopic examination of the sample surface area versus a more thorough examination that involves combing through the sample;
- Additional grinding of fine ground samples prior to examination; and
- Use of different size containers for stereomicroscopic evaluations.

To address these issues QATS recommends further standardizing the method by having all of the laboratories use the same size containers and perform additional grinding and stereo-microscopic evaluation in the same manner. One other issue discussed with the laboratories is the wisdom of performing the LDC analyses on the same slides as the original analyses rather than on a new preparation altogether, which is how the LDS analyses are performed.

7.3.3 NIOSH Methods 9002 (PLM) and 7400 (PCM)

The laboratory QC analysis associated with PCM analyses are not currently recorded in the available EDDs, and were entered sporadically for PLM. Since these data were not recorded in the EDDs, they were not uploaded to the database. Review of these results is therefore incomplete. QATS recommends that moving forward (and also retroactively back to January 1, 2013) QC analyses performed for both NIOSH methods 9002 and 7400 be recorded on EDDs.

7.4 Data Validation

Very few Libby asbestos data were qualified. Qualifiers were applied to seven field samples and one QC sample (re-preparation) of the 2,227 asbestos samples validated (0.31%), resulting in 99.7% of the Libby asbestos results for samples analyzed between 2010 and 2012 required no qualification. Five samples and one QC sample were qualified due to the failure of the laboratory to perform and/or document daily calibration activities and two samples were qualified for field blank contamination.

Data packages reviewed were often incomplete, had never been submitted, or multiple revisions were available with no narratives to determine what had been changed. In addition, a comparison of the raw data (bench sheets) to the information in the EDDs revealed data omissions and typographical errors, further complicating the validation process. Discrepancies were observed in the bench sheet/EDD information comparisons due to information omissions and typographical errors. The discrepancies ranged from minor (i.e., typographical errors or omissions in fields that do not affect the sample results) to more severe discrepancies (i.e., typographical errors for air volume and minimum aspect ratio which could affect the sample result, or date analyzed discrepancies which could affect the daily calibration verification).

While a low percentage of data evaluated needed qualification, the relatively high level of EDD to bench sheet discrepancies (11.4%) suggests a need to consider performing complete reviews of both hard copy and electronic deliverables upon receipt, and prior to loading data results into the Libby database. Also, some of the data packages posted by the laboratories were incomplete or were not in the designated locations. The laboratory procedures for data package review and archiving should be evaluated during the next on-site audit.

7.5 On-site Audits

Overall, for the 2012 on-site audits there was a 39.4% decrease observed in the average number of defects per on-site audit (for the same six laboratories) recorded in 2008. All six laboratories audited in 2008 and again in 2012 showed a reduction in the number of defects, which suggests that all laboratories applied corrective action in response to their first audits in 2008. Laboratory responses, in the form of proposed corrective actions to the identified deficiencies, were submitted by the laboratories for both the 2008 and 2012 audits. No findings were contested. These laboratory-proposed corrective actions in response to the 2012 audits will be verified during the next round of scheduled audits.

With the 39.4% reduction in the average number of defects between the laboratories audited in 2008 and again in 2012 suggests that an on-site audit program is effective in improving laboratory quality and compliance. It is recommended that the on-site audit program continue, with annual on-site audits scheduled at the Libby asbestos support laboratories and sample preparation facilities. QATS will use information gathered from the validation process, PLM and TEM Inter-labs, and feedback from data users to further enhance the on-site audit process.

8.0 References

Nelson W., Applied Life Data Analysis, John Wiley & Sons, New York, 1982.

NIST,. Airborne Asbestos Method: Standard Test Method for Verified Analysis of Asbestos by Transmission Electron Microscopy – Version 2.0. National Institute of Standards and Technology, Washington DC. NISTIR 5351, March 1994.

QATS Data Auditing Group, Annual QA/QC Summary Report (2007-2012) for Task Order 2021 Quality Assurance (QA) Support for Remedial Investigation/Feasibility Study (RI/FS) at Site OU3 Nevada, 2013.

ATTACHMENT 1

List of Asbestos Data Validation Deliverables

Asbestos Lab Job Numbers Selected for Validation 2010-2012

Year	Laboratory	Lab Job No.	Method/Media	Number of Samples
2010	EMSL, Beltsville, MD	191004378	PLM-VE/Soil	50
2010	EMSL, Denver, CO	221001904	TEM-AHERA/Air	4
2010	EMSL, Denver, CO	221001653	PLM-GRAV/Soil	8
2010	EMSL, Denver, CO	221001486	PLM-VE/Soil	21
2010	EMSL, Denver, CO	221001966	PLM-VE/Soil	23
2010	EMSL, Libby, MT	271000550	TEM-ISO/Air	2
2010	EMSL, Libby, MT	271000274	TEM-ISO/Air	9
2010	EMSL, Libby, MT	271000980	TEM-ISO/Air	18
2010	EMSL, Libby, MT	271001369	TEM-ISO/Air	20
2010	EMSL, Libby, MT	271001089	TEM-ASTM/Dust	6
2010	EMSL, Libby, MT	271000088	TEM-AHERA/Air	3
2010	EMSL, Libby, MT	271001337	TEM-AHERA/Air	3
2010	EMSL, Libby, MT	271001462	TEM-AHERA/Air	3
2010	EMSL, Libby, MT	271000173	TEM-AHERA/Air	5
2010	EMSL, Libby, MT	271000652	TEM-AHERA/Air	5
2010	EMSL, Libby, MT	271000963	TEM-AHERA/Air	5
2010	EMSL, Libby, MT	271001185	TEM-AHERA/Air	5
2010	EMSL, Libby, MT	271001484	TEM-AHERA/Air	6
2010	EMSL, Libby, MT	271000338	TEM-AHERA/Air	6
2010	EMSL, Libby, MT	271000682	TEM-AHERA/Air	6
2010	EMSL, Libby, MT	271000812	TEM-AHERA/Air	6
2010	EMSL, Libby, MT	271000846	TEM-AHERA/Air	6
2010	EMSL, Libby, MT	271001182	TEM-AHERA/Air	6
2010	EMSL, Libby, MT	271001396	TEM-AHERA/Air	6
2010	EMSL, Libby, MT	271000432	TEM-AHERA/Air	7
2010	EMSL, Libby, MT	271000898	TEM-AHERA/Air	7
2010	EMSL, Libby, MT	271001105	TEM-AHERA/Air	6
2010	EMSL, Libby, MT	271001569	TEM-AHERA/Air	7
2010	EMSL, Libby, MT	271000375	TEM-AHERA/Air	10
2010	EMSL, Libby, MT	271000809	PLM-VE/Soil	5
2010	EMSL, Libby, MT	271000939	PLM-VE/Soil	5
2010	EMSL, Libby, MT	271000234	PLM-VE/Soil	6
2010	EMSL, Libby, MT	271001513	PLM-VE/Soil	14
2010	EMSL, Libby, MT	271000555	PLM-GRAV/Soil	17
2010	EMSL, Libby, MT	271001051	PLM-9002/Soil	5
2010	EMSL, Libby, MT	271001281	PLM-9002/Soil	5
2010	EMSL, Libby, MT	271000164	PLM-9002/Soil	6
2010	EMSL, Libby, MT	271000610	PLM-9002/Soil	6
2010	EMSL, Libby, MT	271000750	PLM-9002/Soil	8
2010	EMSL, Libby, MT	271000938	PLM-9002/Soil	8
2010	EMSL, Libby, MT	271000560	PLM-9002/Soil	9
2010	EMSL, Libby, MT	271001347	PLM-9002/Soil	10
2010	EMSL, Libby, MT	271001093	PLM-9002/Soil	14
2010	EMSL, Libby, MT	271000049	PCM-7400/Air	3
2010	EMSL, Libby, MT	271001475	PCM-7400/Air	3
2010	EMSL, Libby, MT	271001563	PCM-7400/Air	3
2010	EMSL, Libby, MT	271000117	PCM-7400/Air	4

Asbestos Lab Job Numbers Selected for Validation 2010-2012

Year	Laboratory	Lab Job No.	Method/Media	Number of Samples
2010	EMSL, Libby, MT	271000406	PCM-7400/Air	4
2010	EMSL, Libby, MT	271000633	PCM-7400/Air	4
2010	EMSL, Libby, MT	271001307	PCM-7400/Air	6
2010	EMSL, Libby, MT	271000965	PCM-7400/Air	8
2010	EMSL, Libby, MT	271000971	PCM-7400/Air	8
2010	EMSL, Libby, MT	271001097	PCM-7400/Air	12
2010	ESATR8, Golden, CO	A101012	PLM-VE/Soil	23
2010	ESATR8, Golden, CO	A101014	PLM-VE/Soil	29
2010	ESATR8, Golden, CO	A101052	PLM-VE/Soil	7
2010	ESATR8, Golden, CO	A101083	PLM-VE/Soil	6
2010	ESATR8, Golden, CO	A101138	PLM-VE/Soil	21
2010	ESATR8, Golden, CO	A101160	PLM-VE/Soil	12
2010	ESATR8, Golden, CO	A101230	PLM-VE/Soil	9
2010	ESATR8, Golden, CO	A101277	PLM-VE/Soil	22
2010	ESATR8, Golden, CO	A101352	PLM-VE/Soil	5
2010	ESATR8, Golden, CO	A101013	PLM-GRAV/Soil	11
2010	ESATR8, Golden, CO	A101021	PLM-GRAV/Soil	9
2010	ESATR8, Golden, CO	A101044	PLM-GRAV/Soil	7
2010	ESATR8, Golden, CO	A101106	PLM-GRAV/Soil	6
2010	ESATR8, Golden, CO	A101148	PLM-GRAV/Soil	5
2010	ESATR8, Golden, CO	A101209	PLM-GRAV/Soil	10
2010	ESATR8, Golden, CO	A101240	PLM-GRAV/Soil	4
2010	ESATR8, Golden, CO	A101287	PLM-GRAV/Soil	3
2010	ESATR8, Golden, CO	A101367	PLM-GRAV/Soil	5
2010	Hygeia, Sierra Madre, CA	38995100021	PLM-VE/Soil	23
2010	Hygeia, Sierra Madre, CA	38995100041	PLM-VE/Soil	21
2010	Hygeia, Sierra Madre, CA	38995100018	PLM-GRAV/Soil	11
2010	Hygeia, Sierra Madre, CA	38995100030	PLM-GRAV/Soil	5
2010	Hygeia, Sierra Madre, CA	38995100048	PLM-GRAV/Soil	2
2010	Reservoirs, Denver, CO	186155	TEM-AHERA/Air	8
2010	Reservoirs, Denver, CO	196488	TEM-AHERA/Air	5
2010	Reservoirs, Denver, CO	191831	PLM-VE/Soil	23
2010	Reservoirs, Denver, CO	196214	PLM-VE/Soil	21
2010	Reservoirs, Denver, CO	192358	PLM-GRAV/Soil	8
2010	EMSL, Denver, CO	221002018	TEM-AHERA/Air	3
2010	EMSL, Denver, CO	221002019	TEM-ASTM/Dust	3
2010	EMSL, Denver, CO	221002327	TEM-ISO/Air	9
2010	EMSL, Libby, MT	271001216	PCM-7400/Air	3
2010	EMSL, Libby, MT	271000844	PLM-VE/Soil	16
2010	EMSL, Libby, MT	271000162	TEM-AHERA/Air	8
2010	EMSL, Libby, MT	271000469	TEM-ASTM/Dust	5
2010	EMSL, Libby, MT	271000258	TEM-ISO/Air	4
2010	EMSL, Libby, MT	271000920	TEM-ISO/Air	9
2010	ESATR8, Golden, CO	A101035	PLM-VE/Soil	9
2010	ESATR8, Golden, CO	A101079	PLM-VE/Soil	12
2010	ESATR8, Golden, CO	A101177	PLM-VE/Soil	14
2010	ESATR8, Golden, CO	A101268	PLM-VE/Soil	12

Asbestos Lab Job Numbers Selected for Validation 2010-2012

Year	Laboratory	Lab Job No.	Method/Media	Number of Samples
2010	Hygeia, Sierra Madre, CA	38995100040	PLM-VE/Soil	20
2010	Reservoirs, Denver, CO	192870	TEM-ISO/Air	8
2011	EMSL, New Jersey	271101243	TEM-ISO/Air	4
2011	EMSL, Beltsville, MD	271101275	TEM-ISO/Air	5
2011	EMSL, Denver, CO	221103017	TEM-AHERA/Air	4
2011	EMSL, Libby, MT	271100043	PCM-7400/Air	5
2011	EMSL, Libby, MT	271100498	PCM-7400/Air	6
2011	EMSL, Libby, MT	271100738	PCM-7400/Air	4
2011	EMSL, Libby, MT	271100902	PCM-7400/Air	9
2011	EMSL, Libby, MT	271100982	PCM-7400/Air	9
2011	EMSL, Libby, MT	271101510	PCM-7400/Air	8
2011	EMSL, Libby, MT	271100192	PLM-9002/Soil	6
2011	EMSL, Libby, MT	271100286	PLM-9002/Soil	8
2011	EMSL, Libby, MT	271100332	PLM-9002/Soil	6
2011	EMSL, Libby, MT	271100368	PLM-9002/Soil	7
2011	EMSL, Libby, MT	271100427	PLM-9002/Soil	4
2011	EMSL, Libby, MT	271100437	PLM-9002/Soil	6
2011	EMSL, Libby, MT	271100534	PLM-9002/Soil	5
2011	EMSL, Libby, MT	271100715	PLM-9002/Soil	9
2011	EMSL, Libby, MT	271100949	PLM-9002/Soil	7
2011	EMSL, Libby, MT	271101088	PLM-9002/Soil	4
2011	EMSL, Libby, MT	271101136	PLM-9002/Soil	6
2011	EMSL, Libby, MT	271101192	PLM-9002/Soil	11
2011	EMSL, Libby, MT	271100166	PLM-VE/Soil	7
2011	EMSL, Libby, MT	271100343	PLM-VE/Soil	4
2011	EMSL, Libby, MT	271100485	PLM-VE/Soil	4
2011	EMSL, Libby, MT	271100934	PLM-VE/Soil	4
2011	EMSL, Libby, MT	271101129	PLM-VE/Soil	3
2011	EMSL, Libby, MT	271101520	PLM-VE/Soil	4
2011	EMSL, Libby, MT	271100007	TEM-AHERA/Air	6
2011	EMSL, Libby, MT	271100045	TEM-AHERA/Air	6
2011	EMSL, Libby, MT	271100077	TEM-AHERA/Air	6
2011	EMSL, Libby, MT	271100114	TEM-AHERA/Air	5
2011	EMSL, Libby, MT	271100162	TEM-AHERA/Air	6
2011	EMSL, Libby, MT	271100377	TEM-AHERA/Air	5
2011	EMSL, Libby, MT	271100572	TEM-AHERA/Air	6
2011	EMSL, Libby, MT	271100788	TEM-AHERA/Air	6
2011	EMSL, Libby, MT	271101014	TEM-AHERA/Air	3
2011	EMSL, Libby, MT	271101210	TEM-AHERA/Air	5
2011	EMSL, Libby, MT	271101511	TEM-AHERA/Air	7
2011	EMSL, Libby, MT	271101570	TEM-AHERA/Air	4
2011	EMSL, Libby, MT	271100692	TEM-ASTM/Dust	4
2011	EMSL, Libby, MT	271100013	TEM-ISO/Air	4
2011	EMSL, Libby, MT	271100632	TEM-ISO/Air	5
2011	EMSL, Libby, MT	271100083	TEM-ISO/Soil	1
2011	EMSL, Libby, MT	271101159	TEM-ISO/Water	2
2011	EMSL, Libby, MT	271101359	TEM-ISO/Water	2

Asbestos Lab Job Numbers Selected for Validation 2010-2012

Year	Laboratory	Lab Job No.	Method/Media	Number of Samples
2011	ESATR8, Golden, CO	A111031	PLM-GRAV/Soil	3
2011	ESATR8, Golden, CO	A101343	PLM-VE/Soil	23
2011	ESATR8, Golden, CO	A111009	PLM-VE/Soil	12
2011	ESATR8, Golden, CO	A111012	PLM-VE/Soil	11
2011	ESATR8, Golden, CO	A111032	PLM-VE/Soil	18
2011	ESATR8, Golden, CO	A111048	PLM-VE/Soil	17
2011	ESATR8, Golden, CO	A111097	PLM-VE/Soil	15
2011	ESATR8, Golden, CO	A111153	PLM-VE/Soil	19
2011	ESATR8, Golden, CO	A111189	PLM-VE/Soil	17
2011	ESATR8, Golden, CO	A111206	PLM-VE/Soil	15
2011	ESATR8, Golden, CO	A111242	PLM-VE/Soil	18
2011	ESATR8, Golden, CO	A111278	PLM-VE/Soil	12
2011	ESATR8, Golden, CO	A111332	PLM-VE/Soil	21
2011	ESATR8, Golden, CO	A111340	PLM-VE/Soil	12
2011	Hygeia, Sierra Madre, CA	38995110012	PLM-VE/Soil	21
2011	Hygeia, Sierra Madre, CA	38995110023	TEM-AHERA/Air	4
2011	Hygeia, Sierra Madre, CA	38995110005	TEM-ISO/Air	10
2011	Reservoirs, Denver, CO	219657	TEM-ISO/Air	9
2011	EMSL, Denver, CO	221102857	TEM-AHERA/Air	3
2011	EMSL, Denver, CO	221102855	TEM-ASTM/Dust	1
2011	EMSL, Denver, CO	221101126	TEM-ISO/Air	9
2011	EMSL, Libby, MT	271100278	PCM-7400/Air	2
2011	EMSL, Libby, MT	271101766	TEM-AHERA/Air	3
2011	EMSL, Libby, MT	271100552	TEM-ASTM/Dust	1
2011	EMSL, Libby, MT	271100204	TEM-ISO/Air	9
2011	Reservoirs, Denver, CO	221780	TEM-ISO/Air	7
2011	ESATR8, Golden, CO	A111128	PLM-VE/Soil	17
2012	EMSL, New Jersey	041218907	PLM-VE/Soil	13
2012	EMSL, New Jersey	041220273	TEM-ISO/Soil	8
2012	EMSL, New Jersey	041222755	PLM-GRAV/Soil	1
2012	EMSL, New Jersey	041228018	PLM-VE/Soil	8
2012	EMSL, Libby, MT	041228213	TEM-ISO/Duff	6
2012	EMSL, Libby, MT	041228226	TEM-ISO/Tree Bark	6
2012	EMSL, Beltsville, MD	191207432	PLM-VE/Soil	17
2012	EMSL, Beltsville, MD	191208790	TEM-AHERA/Air	4
2012	EMSL, Beltsville, MD	191212102	PLM-VE/Soil	6
2012	EMSL, Beltsville, MD	191212104	PLM-GRAV/Soil	1
2012	EMSL, Denver, CO	221202671	PLM-VE/Soil	21
2012	EMSL, Denver, CO	221203762	PLM-GRAV/Soil	1
2012	Reservoirs, Denver, CO	245181	TEM-AHERA/Air	4
2012	Reservoirs, Denver, CO	246655	TEM-ISO/Tree Bark	8
2012	Reservoirs, Denver, CO	248398	PLM-VE/Soil	15
2012	EMSL, Libby, MT	271100979	TEM-ISO/Air	9
2012	EMSL, Beltsville, MD	271101241	TEM-ISO/Air	1
2012	EMSL, Libby, MT	271101269	PCM-7400/Air	18
2012	EMSL, Libby, MT	271101527	TEM-ISO/Water	12
2012	EMSL, Libby, MT	271101556	TEM-AHERA/Air	6

Asbestos Lab Job Numbers Selected for Validation 2010-2012

Year	Laboratory	Lab Job No.	Method/Media	Number of Samples
2012	EMSL, Libby, MT	271101557	TEM-AHERA/Air	6
2012	EMSL, Libby, MT	271200017	TEM-AHERA/Air	9
2012	EMSL, Libby, MT	271200037	TEM-AHERA/Air	6
2012	EMSL, Libby, MT	271200050	TEM-AHERA/Air	7
2012	EMSL, Libby, MT	271200054	TEM-AHERA/Air	6
2012	EMSL, Libby, MT	271200063	TEM-AHERA/Air	6
2012	EMSL, Libby, MT	271200075	TEM-AHERA/Air	6
2012	EMSL, Libby, MT	271200089	PCM-7400/Air	6
2012	EMSL, Libby, MT	271200093	TEM-AHERA/Air	8
2012	EMSL, Libby, MT	271200104	PLM-9002/Soil	9
2012	EMSL, Libby, MT	271200156	PLM-9002/Soil	7
2012	EMSL, Libby, MT	271200169	PLM-9002/Soil	7
2012	EMSL, Libby, MT	271200193	PLM-9002/Soil	7
2012	EMSL, Libby, MT	271200202	PLM-9002/Soil	8
2012	EMSL, Libby, MT	271200212	PLM-9002/Soil	8
2012	EMSL, Libby, MT	271200214	PCM-7400/Air	4
2012	EMSL, Libby, MT	271200219	PLM-9002/Soil	9
2012	EMSL, Libby, MT	271200231	PLM-9002/Soil	4
2012	EMSL, Libby, MT	271200247	PLM-VE/Soil	15
2012	EMSL, Libby, MT	271200280	TEM-ISO/Water	5
2012	EMSL, Libby, MT	271200593	PLM-VE/Soil	19
2012	EMSL, Libby, MT	271200771	TEM-ASTM/Dust	2
2012	EMSL, Libby, MT	271200783	PLM-GRAV/Soil	4
2012	EMSL, Libby, MT	271200791	PLM-GRAV/Soil	4
2012	EMSL, Libby, MT	271201143	PLM-9002/Bulk	1
2012	EMSL, Libby, MT	271201173	TEM-ISO/Soil	14
2012	Hygeia, Sierra Madre, CA	38995120014	PLM-VE/Soil	12
2012	Hygeia, Sierra Madre, CA	38995120011	PLM-VE/Soil	13
2012	Hygeia, Sierra Madre, CA	38995120018	PLM-VE/Soil	16
2012	Hygeia, Sierra Madre, CA	38995120021	PLM-VE/Soil	15
2012	Hygeia, Sierra Madre, CA	38995120028	PLM-GRAV/Soil	4
2012	Hygeia, Sierra Madre, CA	PLM-VE/Soil	PLM-VE/Soil	13
2012	Hygeia, Sierra Madre, CA	38995120093	TEM-ISO/Tree Bark	3
2012	Hygeia, Sierra Madre, CA	38995120097	TEM-AHERA/Air	3
2012	Hygeia, Sierra Madre, CA	38995120144	TEM-ISO/Duff	6
2012	ESATR8, Golden, CO	A120006	PLM-VE/Soil	8
2012	ESATR8, Golden, CO	A120040	PLM-GRAV/Soil	4
2012	ESATR8, Golden, CO	A120041	PLM-VE/Soil	5
2012	ESATR8, Golden, CO	A120042	PLM-GRAV/Soil	2
2012	ESATR8, Golden, CO	A120047	PLM-VE/Soil	9
2012	ESATR8, Golden, CO	A120050	PLM-VE/Soil	9
2012	ESATR8, Golden, CO	A120053	PLM-VE/Soil	11
2012	ESATR8, Golden, CO	A120080	PLM-VE/Soil	9
2012	ESATR8, Golden, CO	A120083	PLM-VE/Soil	15
2012	ESATR8, Golden, CO	A120085	PLM-VE/Soil	18
2012	ESATR8, Golden, CO	A120099	PLM-VE/Soil	15
2012	ESATR8, Golden, CO	A120110	PLM-VE/Soil	22

Asbestos Lab Job Numbers Selected for Validation 2010-2012

Year	Laboratory	Lab Job No.	Method/Media	Number of Samples
2012	ESATR8, Golden, CO	A120127	PLM-VE/Soil	15
2012	ESATR8, Golden, CO	A120134	PLM-VE/Soil	21
2012	ESATR8, Golden, CO	A120183	TEM-AHERA/Air	4
2012	ESATR8, Golden, CO	A120266	TEM-ISO/Air	6
2012	ESATR8, Golden, CO	A120533	PLM-VE/Sediment	18
2012	ESATR8, Golden, CO	A120534	PLM-GRAV/Sediment	15
2012	Reservoirs, Denver, CO	221789	TEM-ISO/Air	4
2012	Reservoirs, Denver, CO	227795	TEM-ASTM/Dust	1
2012	Reservoirs, Denver, CO	241059	PCM-7400/Air	3
2012	Reservoirs, Denver, CO	240162	TEM-AHERA/Air	3
2012	EMSL, New Jersey	041232099	TEM-ISO/Air	26
2012	EMSL, Beltsville, MD	191208791	TEM-ISO/Air	6
2012	EMSL, Denver, CO	221101656	TEM-ISO/Air	4
2012	EMSL, Denver, CO	221202716	PLM-VE/Soil	5
2012	EMSL, Denver, CO	221203188	TEM-ASTM/Dust	2
2012	EMSL, Libby, MT	271101277	TEM-ISO/Air	7
2012	EMSL, Libby, MT	271200935	PCM-7400/Air TEM-AHERA/Air	5 2
2012	EMSL, Libby, MT	271200965	TEM-ASTM/Dust	3
2012	EMSL, Libby, MT	271201138	PLM-VE/Soil	19
2012	Hygeia, Sierra Madre, CA	38995120137	TEM-ISO/Air	6
2012	Hygeia, Sierra Madre, CA	38995120150	PCM-7400/Air	3
2012	Hygeia, Sierra Madre, CA	38995120151	TEM-AHERA/Air	3
2012	Hygeia, Sierra Madre, CA	38995120152	TEM-ASTM/Dust	3
2012	Hygeia, Sierra Madre, CA	38995120159	PLM-VE/Soil	15
2012	ESATR8, Golden, CO	A120221	TEM-AHERA/Air	3
2012	ESATR8, Golden, CO	A120277	PLM-VE/Soil	6
2012	ESATR8, Golden, CO	A120309	TEM-ASTM/Dust	1
2012	ESATR8, Golden, CO	A120586	TEM-ISO/Air	6
Total				**2,227**